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IN ALL ITS APPLICATIONS TO

PHARMACY, ARTS, AND MANUFACTURES.

EDITED BY

WILLIAM CROOKES, F.R.S., &c.

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THE COMMITTEE ON ADULTERATION.

THE Select Committee on the Adulteration of Food completed their task of receiving evidence on the 22nd ult. Among the chemists examined were Drs. Hassall, Cameron, Tidy, and Voelcker, and Messrs. Wanklyn, Allen, Bartlett, and Sutton. Although the leading public analysts and workers on the detection of adulteration are fairly represented here, and we might therefore have expected that the matter would be thoroughly sifted, it is remarkable how many notorious adulterations were left absolutely unnoticed, and how various were the opinions expressed on different subjects. Thus Dr. Hassall and Dr. Voelcker thought the facing of tea should be prohibited, though the latter chemist " would not have considered 1½ per cent of facing (the usual amount) an adulteration." Mr. Wanklyn thought faced tea should not be regarded as adulterated, while Mr. Allen considered the facing an adulteration when black tea was converted into green, and thus given a fictitious value, while he would not condemn a faced green tea merely coloured more brightly to suit the public taste.

But perhaps the most startling difference of opinion was on the subject of butter, Dr. Voelcker and Mr. Wanklyn having apparently denied the possibility of detecting foreign fats, while Dr. Hassall and Dr. Tidy were equally certain of the possibility. There can be little doubt that the recognition of such adulteration in butter is frequently possible, but we can well imagine that there are cases, like that referred to by Mr. Wanklyn, in which their detection is impossible, and few chemists will doubt Mr. Wanklyn's ability to concoct a mixed butter in which Dr. Tidy would fail to detect the foreign fat.

Dr. Voelcker and Mr. Wanklyn, though of the same mind with regard to butter, were at variance on the subject of milk, Mr. Wanklyn maintaining the accuracy of his "standard," and Dr. Voelcker disputing the possibility of detecting much less than 25 per cent of water. We quite agree with the latter chemist that, if we rely on the *density* of the milk (as recently advocated by him), less than 25 per cent of water cannot be detected with certainty, but then no chemist but Dr. Voelcker would rely on the density of milk for the detection of adulteration. In fact, Dr. Voelcker strongly objected to the use of any standards at all, and thought every case should be judged on its merits. Dr. Voelcker is also reported to have said that he would not himself accept a position as a public analyst, as it would lead to him being classed with chemists who did not stand very high in the profession. We do not for a moment doubt that Dr. Voelcker could have held such a position had he desired to do so, and the very fact that chemists of good standing have declined the posts is the reason that many of the appointments are held by third-rate men. In casting this slur on a body of chemists who have had many difficulties to overcome, Dr. Voelcker seems to forget that, as an agricultural chemist, he is already classed with " some chemists who do not stand very high in the profession." On the whole, we are rather inclined to agree with Dr. Hassall, that there is more fault to be found with the Act than with the analysts, and that chemists who are always ready to give evidence for the defence should be regarded with suspicion.

Most of the chemists examined were asked their opinion as to the desirability of appointing referees for the decision of disputed cases. Dr. Hassall thought such an appointment was unnecessary, while Dr. Voelcker and others recommended the utilisation of the Inland Revenue Laboratory at Somerset House for the purpose, a plan which Mr. Wanklyn did not think would command the confidence of the profession. While admitting the advantages of the Inland Revenue Laboratory, Mr. Allen preferred the appointment of independent referees, to be elected annually by the public analysts themselves, a plan which he thought would ensure the election of the best men, and prevent the evil effects of personal influence, which so often causes the appointment of second-rate or incompetent men to important posts. Mr. Allen also advocated the personal attendance of the analyst at the hearing of the case, on the ground that his statement was the very cause of the prosecution, and that he ought to be confronted with the defendant. Though this argument has some force, and the personal attendance of the analyst may be possible in the boroughs, it would certainly be a mistake to make it essential to the case, as it would involve great difficulties in the country districts, and might cause many cases in which adulteration was detected to remain unreported.

Dr. Tidy is reported to have said that he had examined about 1000 samples of food a month, and, unless we attribute to him a capacity for work such as might have been possessed by Briareus, we must agree with Dr. Voelcker that " this is not the way that analyses should be made, for it was impossible, from the number made, to take every case carefully, and thoroughly examine every sample with the *minutiæ* necessary to arrive at the truth." And yet Dr. Voelcker advocated the concentration of the appointments in the hands of a few analysts, a course which would necessarily tend to increase the very evil he deplores !

On the whole, we believe it is impossible to over-rate the good done by the inquiry, and we are glad to observe that the chemists examined were unanimous in their opinion of the good effected by the Act, imperfect as it at present is.

CHEMISTRY APPLIED TO THE DETECTION OF ADULTERATION.

By ALFRED H. ALLEN, F.C.S.

(Continued from p. 222.)

II. TEA (concluded).

Moisture.—The moisture of tea in the commercial condition is generally about 6 or 8 per cent of the weight. All the data given of the proportions of tannin, insoluble matter, ash, &c., refer to the tea in its commercial state. The lowest recorded percentage of moisture is 4·9, and the highest about 10.

Extractive Matter.—Some chemists prefer to evaporate to dryness the aqueous decoction of the tea instead of weighing the residual leaves. It is evident that the extractive matter, *plus* the moisture, subtracted from 100·0, will be the percentage of insoluble matter. Thus Peligot found—

	Green Tea (Gunpowder).	Black Tea (Souchong).
Moisture	10	8
Extractive matter ..	47	43
Insoluble matter ..	43	49
	100	100

The most recent published determinations of the extractive matter in tea are those of Mr. Wigner,[*] but, as in almost every instance the ash is abnormally high, in one case even exceeding the total ash found in the original tea, his results must be accepted with caution.

Theine.—Although the very variable proportion of theine present in tea prevents the estimation from being of much value for the detection of adulteration, it may sometimes be of interest to determine the amount present in a particular sample. The recorded percentages of theine vary greatly even with the same observers, Mr. Bell, for instance, having found amounts varying from 1·9 to 5·8 per cent. Stenhouse places the average proportion of theine in black tea at 2 per cent, while Peligot found upwards of 6 per cent.

The advantages of the various methods employed for the estimation of theine have been compared by R. Weyrich.[†] I have myself used Peligot's, Mulder's, and Zöller's methods, and am not satisfied with either of them on the score either of simplicity or accuracy. Zöller's plan is the least satisfactory of the three. A good process for the estimation of theine is still a desideratum, but I have employed the following method of *extracting* theine with very satisfactory results, though it is valueless for the *determination*, owing to the decomposition of some of the theine by the lime :—

The tea is finely powdered and mixed into a paste with slaked lime and water, and allowed to rest for some hours, with occasional stirring. The mixture next is dried at a steam heat, and repeatedly treated with boiling benzol in an apparatus allowing of the condensation of the vapour, until no more colouring matter is extracted. The liquid is filtered, and the benzol distilled off. The residue, consisting of impure theine, is boiled with water, and the solution filtered while hot. On evaporation of the aqueous solution, the theine is deposited in long silky crystals, often grouped into tufts. It is usually obtained quite pure by the above treatment.

Theine being a very weak base, the salts are readily decomposed even by dilution. One of its most remarkable salts is the tannate. If a solution of gallo-tannic acid be added in excess to a cold aqueous solution of theine, a white precipitate of tannate of theine is produced. This is far more soluble in hot water than in cold, so that at a certain temperature, dependent on the concentration of the solution, the liquid becomes clear, and, if the vessel containing it be cooled externally by a jet of water, a local precipitation takes place where the cooling occurs.[†] On again heating the liquid it becomes clear, and the experiment may be repeated any number of times, a few degrees difference of temperature being sufficient to produce the change. On standing the precipitate collects at the bottom of the vessel as a sticky mass, capable of re-solution without change on application of heat.

The above facts clearly prove the necessity of using hot water for extracting the theine from tea, and seem to indicate the probable cause of the turbidity noticed when strong infusions of certain Indian teas are cooled.

According to Mulder, tannate of theine contains 41·9 per cent of theine.

Under the action of oxidising agents, theine behaves like uric acid, and forms a coloured product analogous to alloxantin, capable of conversion into a murexide-like substance by the action of ammonia. These facts may be utilised for the detection of theine, but the test requires to be applied with caution.

The residue supposed to contain theine is moistened with strong hydrochloric acid, a small crystal of potassium chlorate is added, and the mixture exposed to a steam heat for some minutes, after which it is subjected cautiously to the action of ammonia, an excess being avoided. A crimson or purple colouration proves the presence of theine.

Theine is fusible at 178° C., and sublimes unchanged at 185°, and is deposited in beautiful acicular crystals. Theine is readily soluble in hot water, the solution depositing on cooling a mass of crystals of the composition $C_8H_{10}N_4O_2 + H_2O$.

Analyses of Tea.

In the following tables I have given the results of the analyses of a number of genuine teas. I have only been able to avail myself of recent analyses, partly because the methods of examination are new, and partly because most observers have omitted to mention the kinds of tea employed, or to indicate the details of the methods used, thus rendering it impossible to utilise their results :—

Percentage of Theine in Tea.

	Percentage.	Kind of Tea.	Observer.
Highest amount..	6·21	Gunpowder	Peligot.
,, ,,	5·8	—	Bell.
Lowest amount ..	1·9	—	Bell.
,, ,,	1·02	Congou	Stenhouse.
Average	2·00	Black	Stenhouse.

The common descriptions of tea often contain as much theine as the finest.

Percentage of Tannin in Green Tea.

	Percentage.	Kind of Tea.	Observer
By gelatin—			
Highest.. ..	19·2	Mixed hyson and gunpowder	Allen.
Lowest	10·12	Very fine gunpowder	Bell.

Percentage of Tannin in Black Tea.

	Percentage.	Kind of Tea.	Observer.
By gelatin—			
Highest.. ..	15·2	Very strong Oolong congou	Allen.
Lowest	9·5	Finest Souchong	Bell.
Average of 8..	10·97	Congou and Souchong	Bell.
By lead—			
Highest.. ..	11·6	Horniman's black	Allen.
Lowest	8·5	Broken leaf congou	Allen.
Average of 28	10·0	Various	Allen.

The proportion of tannin appears rather to *increase* as the leaf gets older.

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[*] *Pharmaceutical Journal*, May 16, 1874.
[†] *Journ. Chem. Soc.*, 1873, p. 1264.
[‡] By using a thin beaker containing a solution of tannate of theine at a temperature just above the precipitating-point, it is possible, by adroitly cooling the exterior with a jet from a washing bottle containing very cold water, to cause the precipitation to follow the track of the stream, and thus to write with water. The extreme sensitiveness of tannate of theine to change of temperature might enable it to be employed as a thermascope.—A. H. A.

Percentage of Insoluble Matter in Black Tea.

	Percentage.	Kind of Tea.	Observer.
On whole leaves—			
Highest.. ..	60·12	Kaisow Congou	Bell.
Average of 5..	58·77	Congou and Souchong	Bell.
On pounded tea—			
Highest.. ..	53·6	Moning Congou	Allen.
Lowest.. ..	46·7	Pekoe	Allen.
Average of 13	49·0	Various	Allen.

The insoluble matter increases somewhat with the age of the leaf.

Percentage of Ash in Tea.

	Highest Amount.	Lowest Amount.	Average.	Observer.
Total ash	6·06	5·30	(of 7) 5·75	Wanklyn.
,, ,,	6·15	5·32	(of 9) 5·66	Wilson.
,, ,,	5·99	5·53	(of 24) 5·66	Wigner.
,, ,,	6·34	5·30	(of 10) 5·75	Allen.
Soluble in water	3·80	3·06	(of 10) 3·34	Allen.
,, ,,	3·35	2·75	(of 24) 3·01	Wigner.
,, ,,	3·33	2·66	(of 9) 3·00	Wilson.
Alkalinity as K_2O	1·88	1·36	(of 20) 1·62	Wigner.
Silica	0·71	0·16	(of 24) 0·44	Wigner.
,,	0·82	0·20	(of 9) 0·53	Wilson.
Ferric oxide ..	0·09	0·03	(of 9) 0·063	Wilson.
,, ,,	0·26	0·16	(of 3) 0·21	Hassall.

A low soluble ash usually indicates an inferior tea. Assam tea, however, frequently gives a low soluble ash. The composition of the ash of tea varies somewhat with the age of the leaf, the potash and phosphoric acid diminishing as the leaf becomes aged.

The following analyses by Zöller show the composition of the ash of tea before and after infusion :—

	Original Tea.	Infused Leaves.
Potash	39·22	7·34
Soda	0·65	0·69
Magnesia	6·47	11·45
Lime	4·34	10·76
Ferric oxide	4·38	9·53
Manganous oxide	1·63	1·97
Phosphoric acid	14·55	25·41
Sulphuric acid	trace	trace
Silica	4·35	7·57
Carbonic acid	24·30	25·28
Chlorine	0·81	trace
	100·00	100·00

It will be observed that more than three-fourths of the total potash is lost by infusion, so that the alkalinity of the ash is a valuable guide in determining whether a sample of tea has been mixed with previously infused leaves ; but as the percentage of potash also diminishes as the leaf ages, the conclusion is somewhat fallacious. The percentage of phosphoric acid, on the other hand, is *diminished* by ageing, and *increased* by infusion, so that we have, in its estimation, another most valuable means of recognising the presence of exhausted leaves.

The following analyses show the proportions of the principal constituents of previously infused leaves :—

	Exhausted. (Bell.)	Maloo Mixture. (Bell.)	Mixed Exhausted. (Allen.)	Exhausted. (Allen.)	Once Infused. (Allen.)	Exhausted. (Wigner.)	Exhausted. (Wigner.)
Moisture..	10·16	8·45	9·5	—	11·1	—	—
Insol. matter (on whole leaves)..	77·21	70·0	—	—	78·5	—	—
Ditto (on powdered tea)	—	—	75·2	72·0	72·3	—	—
Tannin (by gelatin) ..	0·9	0·88	—	—	3·3	—	—
Tannin (by lead).. ..	—	—	2·8	4·0	3·2	—	—
Gum (precipitated by alcohol .. .. ..)	2·5	5·75	—	—	3·8	—	—
Soluble ash	—	—	0·52	0·58	0·75	0·41	0·80
Alkalinity of ash.. ..	—	—	—	—	—	0·43	0·89

Certain kinds of tea are especially liable to particular adulterations, and therefore the examination necessary must depend on the nature of the sample.

Adulteration by siliceous and magnetic matter is almost confined to caper, lie, and gunpowder teas, and mixtures containing them.

Extraneous astringents are often present in the above classes, and occasionally also in ordinary black tea.

Exhausted leaves are re-made into caper and gunpowder, and are also mixed with ordinary tea.

Foreign leaves are met with in teas of all classes.

Black tea is sometimes painted, and sold as gunpowder tea.

(To be continued.)

ON CONIFERINE, AND ITS CONVERSION INTO THE AROMATIC PRINCIPLE OF VANILLA.*

By FERD. TIEMANN and WILH. HAARMAN.

THE sap of the cambium of coniferous trees contains a beautiful crystalline glucoside, coniferine, which was discovered by Hartig, and examined some years ago by Kubel, who arrived at the formula $C_{24}H_{32}O_{12}+3$ aq. A minute study of this compound leads us to represent the molecule of coniferine by the expression $C_{16}H_{22}O_8+2$ aq, the percentages of which nearly coincide with the theoretical values of Kubel's formula.

Submitted to fermentation with emulsine, coniferine splits into sugar and a splendid compound, crystallising in prisms, which fuse at 73°. This body is easily soluble in ether, less so in alcohol, almost insoluble in water ; its composition is represented by the formula $C_{10}H_{12}O_3$. The change is represented by the equation—

$$C_{16}H_{22}O_8 + H_2O = C_6H_{12}O_6 + C_{10}H_{12}O_3.$$
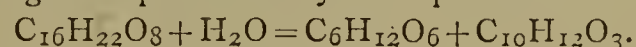
Under the influence of oxidising agents, the products of fermentation undergoes a remarkable metamorphosis. On boiling it with a mixture of potassium bichromate and sulphuric acid, there passes with the vapour of water, in the first place ethylic aldehyd, and subsequently an acid compound soluble in water, from which it may be removed by ether. On evaporating the ethereal solution, crystals in stellar groups are left behind, which fuse at 81°. These crystals have the taste and odour of vanilla.

An accurate comparative examination has proved them to be identical with the crystalline substance which constitutes the aroma of vanilla, and which is often seen covering the surface of vanilla pods.

On analysis, the crystals we obtained were found to contain $C_8H_8O_3$. This is exactly the composition which recent researches of Carles have established for the aromatic principle of vanilla. The transformation of the crystalline product of fermentation into vanilline is represented by the following equation :—

$$C_{10}H_{12}O_3 + O = C_2H_4O + C_8H_8O_3.$$
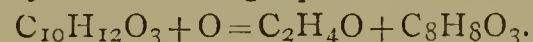
To remove all doubt regarding the identity of artificial vanilline with the natural compound, we have transformed the former into a series of salts, which have the general formula $C_8H_7MO_3$, and into two substitution products, $C_8H_7BrO_3$ and $C_8H_7IO_3$, both of which had previously been prepared by Carles from the natural compound.

In order further to elucidate the nature of vanilline, we have submitted this body to fusion with alkali. The product of this action is a well-known acid discovered by Strecker, and described by him as protocatechuic acid, $C_7H_6O_4$, which is thus formed :—

$$C_8H_8O_3 + HO = C_7H_6O_4 + H_2O + CO_2.$$
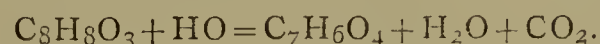
We have identified this substance by analysis, by the study of its reactions, and also by transforming it into pyrocatechine, $C_6H_6O_2$,
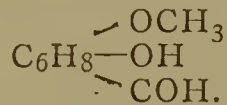
$$C_7H_6O_4 = C_6H_6O_2 + CO_2.$$

The transformation into protocatechuic acid fixes the constitution of vanilline. This compound is the methyl-

* A Paper read before the Royal Society

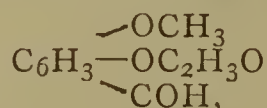ated aldehyd of protocatechuic acid ; its composition referred to benzol is represented by the formula—

$$C_6H_8 \begin{cases} OCH_3 \\ OH \\ COH. \end{cases}$$

Indeed, submitted under pressure to the action of hydrochloric acid, vanilline splits into chloride of methyl and protocatechuic aldehyde—

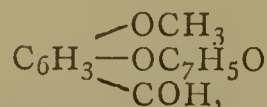$$C_6H_3 \begin{cases} OCH_3 \\ OH \\ COH \end{cases} + HCl = CH_3Cl + C_6H_3 \begin{cases} OH \\ OH \\ COH. \end{cases}$$
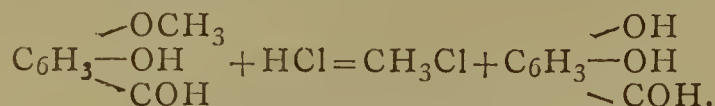
A corresponding action takes place with hydriodic acid; but in this case the aldehyd is destroyed.

An additional proof of the correctness of our view regarding the constitution of vanilline is obtained by treating this substance with acetic anhydride and benzoyl chloride. The action did not go beyond the formation of the compounds—

$$C_6H_3 \begin{cases} OCH_3 \\ OC_2H_3O \\ COH, \end{cases}$$

and—

$$C_6H_3 \begin{cases} OCH_3 \\ OC_7H_5O \\ COH, \end{cases}$$

showing that vanilline does not contain more than one hydroxylic group.

The constitution of vanilline being thus made out, there could be no doubt regarding the structure of the product of fermentation from which vanilline arises. This compound is the ethylic ether of vanilline—

$$C_6H_3 \begin{cases} OCH_3 \\ OC_2H_5 \\ COH. \end{cases}$$
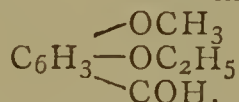
That such is the constitution of the body is proved by the simultaneous formation of ethylic aldehyd when vanilline is formed. We obtained, however, an additional confirmation of this conception by submitting the product of fermentation to the action of hydriodic acid under pressure, when an alcohol iodide was formed, which we succeeded in separating into the iodides of methyl and ethyl—

$$C_6H_3 \begin{cases} OCH_3 \\ OC_2H_5 \\ COH \end{cases} + 2HI = CH_3I + C_2H_5I + C_6H_3 \begin{cases} OH \\ OH \\ COH. \end{cases}$$
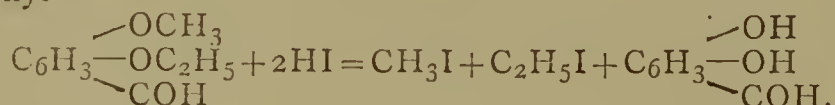
The experiments we have described in this note were performed in the laboratory of Professor A. W. Hofmann, to whom we are deeply indebted for advice and assistance he has given us in the course of these researches.

ON THE

CONDITION OF THE IMPURITIES IN COAL-GASES OF HIGH AND LOW ILLUMINATING POWER.

By CHARLES R. C. TICHBORNE, Ph.D., F.C.S., M.R.I.A., &c.

IN the years 1872 and 1873 I had an opportunity of trying some experiments in connection with the condition of the impurities in gas of a high standard (20 candles). My first experiments were instituted to see how far carbon was actually disseminated through the atmosphere from these gases, or whether a 20-candle gas would, as described by Professor Frankland, owe its higher illuminating power to the radiation of light from denser hydrocarbon vapours or from solid particles.* This enquiry, after a time, developed, as will be seen, into one of another character; but I will first detail my preliminary researches.

It is probable that the main increase in the illuminating power of a gas is due to the causes specified by Professor Frankland, but it is equally certain that, in practice, solid

* Vide "On the Combustion of Hydrogen, Oxygen, and Carbonic Oxide under Great Pressure."—*Proc. Roy. Soc.*, vol. xvi., p. 419.

carbonaceous particles are more freely disseminated from the gas of a high standard than from a low one, say a 16-candle, the conditions being exactly similar as regards burner and supply of air. This fact may be determined in many ways. In one of my experiments four small chambers were constructed for the relative and optical examination of the atmospheres resulting from the combustion of these gases by the electric or lime light. Two chambers are required for the examination of one light ; and the two experiments with the different gases under examination were simultaneously performed.

Filtered air was introduced in one of the chambers, in which the gas was burning from an ordinary fish-tail burner, and the products of combustion passed into the second, or dark chamber, through which passed a beam of bright light. It is very easy to arrange these compartments or chambers in such a manner that a comparative view of the results may be determined by the eye. The combustion of the gas must be regulated by watching the metres provided for the purpose of controlling the supply. It may be objected to such a mode of examination that the light impinging upon the clouds of heavy hydrocarbons would produce similar effects to solid carbon ; but the carbon deposit can be virtually procured by placing cold plates of glass at stated distances over openings along the route of the escaping vapours. An arrangement was made by which cold water was allowed to flow at the back of the plates to keep them cool. These plates will reveal a slight deposit of carbon when examined by the electric or lime light, and from the relative examinations so effected by them, and the previous experiments, there could be little doubt that the high illuminating gas gave a greater deposit, *cæteris paribus.*

These experiments, however, were not followed up, because they gave no pronounced information. The results were not quantitative, and were only confirmatory, to a certain extent, of what our general observations have premised, viz., that 20-candle gas, as made practically in gas retorts, will deposit carbonaceous matter more fully than 16-candle gas. This question, however, is outside the question of illuminating intensity, and is an accidental but an accompanying fact. From my experiments, I am of opinion that coal-gas of the lowest standard, possessing any amount of luminosity worth mentioning, will show traces of this deposit when submitted to searching tests.

My attention was first attracted, in the winter of the year 1872, to the marked effect of the combustion-products of gas on some fabrics dyed with aniline colours, and from certain indications then perceived the following investigations were instituted :—I determined to investigate the products of combustion from different gases possessing different illuminating powers, chemically and quantitatively—the gases to be burnt in as nearly as possible the same condition as we should use them in our ordinary consumption. And as in these experiments my object was to obtain extreme gases, or gases which would present extreme phases as regards their condition, I arranged to have two in use, one of a low illuminating power, obtained by passing the ordinary gas at my disposal through a given volume of spirit. The gas played through the spirit in a specially-arranged vessel, and the results were remarkably uniform if the amount of spirit was regulated with each measure of gas. The spirit was found to be strongly impregnated with the hydrocarbons, and was rejected after each experiment. At the exit of the wash-bottle was arranged a short condensing apparatus of a simple nature, intended to eliminate as much as possible all liquids from the experimental gas. Even the spirit itself is, to a certain extent, found floating onwards, due to the attraction of liquids by miscible vapours. My gas with the high illuminating power was obtained by substituting the light petroleum hydrocarbons (boiling from 25° to 30° C.) for the spirit in the washing apparatus, using the same amount, and rejecting after each experiment as before.

Impurities in Coal-Gas.

From the slowness of the combustion, and the necessary complications of the apparatus, it was quite impossible in such experiments to determine the actual illuminating power of the actual gas performing the experiments ; but when I say that the gas used in one set of experiments marked on an average 12 to 12½-candle gas, and that the carbonised gas marked on an average 21 candles, I think there is little question but that there was margin enough to allow of any slight fluctuations there might be in this respect in the original gas with which I was manipulating.

The experiments were put on at the same hour, and all performed under as like a condition of circumstances as possible. The gas, when burned in Letheby's apparatus, gave 0·41 gr. of sulphur for each 10 feet, and may be considered as a fair specimen of a commercial gas.

The photometer used in these experiments was Bunsen's, with Letheby's modifications. Each observation was made with ten readings taken at minute intervals, and the average formed the determination.

From the unmistakable evidence of sulphurous anhydride ("sulphurous acid") found in a given sample of gas of a high illuminating power, determinations were instituted with regard to this substance, or rather, we should say, the condition of oxidation in which the sulphur molecule would be given off. It is hardly necessary to say that sulphur rarely passes to the burner as sulphide of hydrogen ; if the gas-makers know their business, it is chiefly as sulphide of carbon that it exerts its deleterious influence. Let it be understood, however, that it is immaterial whether the sulphur is present as sulphide of hydrogen or sulphide of carbon ; the products will be SO_2 or SO_3, sulphurous or sulphuric anhydride, according to the perfection of the combustion. The first action of heat upon bisulphide of carbon is to resolve it into its elements, carbon and sulphur, which are burnt, respectively, into carbonic acid and sulphurous anhydride, according to the following equation:—
$$CS_2 + 6O = CO_2 + 2SO_2.$$
Therefore we may consider that the combustion of bisulphide of carbon in coal-gas is tantamount to the combustion of sulphur itself. It is generally stated that the result of the combustion of sulphur in atmospheric air or oxygen is sulphurous acid ; but this is only partially right—in fact, in experiments performed for the purpose I always find that a trace of sulphuric acid is formed, and that much more is formed in the presence of a large supply of oxygen, or in the presence of the lower oxides of nitrogen, which it will be seen further on may probably occur in coal-gas.

Sulphuretted hydrogen burns very easily, and the combustion is generally attended with the production of free sulphur if there is an imperfect access of air, or if the gas is eliminated in large volumes ; but such a decomposition is hardly likely to occur in coal-gas.

The experiments were performed in Letheby's apparatus for the estimation of sulphur in gas. It was very convenient to apply the chemical examination intended to the products of combustion, and the object was not so much the estimation of the sulphur as to get a qualitative examination of the products of combustion. In these experiments 15 to 30 (generally 20) feet of gas were allowed to pass through the metre at the rate of 1½ hours to each foot of gas. The carbonising or decarbonising apparatus (as the case might be) was placed between the meter and the burner, and the products of combustion were mixed with vapour of ammonia, and, by a bent glass chimney, were conveyed into the ordinary large glass cylindrical receiver. In the preliminary experiments, the ammoniacal vapour, used to fix the volatile acid, was introduced just below the burner, with the intention that it should be drawn through the apparatus by the strong draught produced by the combustion. It will be seen that another arrangement had to be adopted, owing to an unforeseen reaction. Two fluid ounces of distilled water were introduced into the receiver to assist and determine the condensation of volatile products, and the whole was supplemented by a very long tube, which

condensed and brought back into the cylinder all the combustible products. The total amount of the sulphur in the gas averaged 4·16 grains per 100 feet, determined by precipitating the products with chlorate of barium (Ba_2ClO_3) in a hot solution.

Having estimated the total sulphur, the object we had in view was now to estimate the amount of sulphur eliminated from the burner as SO_2, and for this purpose a volumetric solution of iodine was used, each 100 c.c. of which represented 0·2 grain of sulphur or 0·4 grain of sulphurous anhydride.

The first experiments were performed with an Argand burner, the ammonia being introduced into the centre of the flame by a tube ; hardly any evidence of sulphites could be found in the receiver, owing to the production of lower oxides of nitrogen. An ordinary fish-tail burner was at this stage of the investigation substituted for the Argand burner, and the following were the results with a 21-candle gas :—

1. (10 feet) required 7 c.c. vol. sol. I.
2. (20 ,,) ,, 8 ,, ,,
3. (30 ,,) ,, 10 ,, ,,

When the products of combustion were acidulated with sulphuric acid previous to the estimation with the volumetric solution, indications were still there of the lower oxides of nitrogen, and, from the discordant results, it was self-evident that there was some cause of error. In fact, the diffusion of the ammoniacal gas was so rapid that part of its vapour was burnt at the expense of the flame under experiment. To remedy this, the ammoniacal gas was so arranged that it should enter the large glass cylinder just where the bent chimney conveying the products entered, so that the cylinder was always full of ammoniacal vapour, but there should not be any in the chimney, the draught being so strong that all the vapours are swept forward through the apparatus with some considerable impetus.

After this arrangement was effected, the experiments proceeded with considerable regularity as will be observed from the following figures :—

30 feet required 35·5 c.c. vol. sol. I.
30 ,, ,, 32·5 ,, ,,
30 ,, ,, 36·0 ,, ,,

showing an average of 11·5 c.c. of the volumetric solution of iodine as being neutralised by the products of combustion of 10 feet. This represents 0·023 of S to the 10 feet, or 0·23 of a grain of sulphur eliminated as sulphurous acid to the 100 feet.

The experiments were repeated, but the gas was decarbonised by passing it through the measured quantity of methylated spirit as detailed. At the conclusion of the experiments, the gas was found saturated with volatile hydrocarbons of the benzol series, and small quantities of hydrocarbons having a high boiling-point.

20 feet required 9·0 c.c. vol. sol. I.
20 ,, ,, 8·0 ,, ,,
20 ,, ,, 11·5 ,, ,,

Average of this gas, therefore, calculated to the 60 feet, only gave ·0095 grain of sulphur as given off in the form of sulphurous acid to each 10 feet.

To sum up these experiments as far as they have gone, we may state that one of the most important observations made consists in the fact that in a gas of a high illuminating power a very large proportion of the sulphur is eliminated as sulphurous acid, that in one of a low illuminating power a considerable portion will be eliminated as sulphuric acid. Another important phase of the combustion is that the ammonia, or such volatile compounds as aniline (if they exist in coal-gas), will be converted into nitrous acid or some of the other low oxides of nitrogen.

The products of the slow combustion of ammonia would seem to be nitrite of ammonia ; and ammoniacal gas and oxygen, according to K. Kraut, is entirely converted into that gas by a spiral of platinum wire. It is also probable

that some bisulphide of carbon is retained by some of the fluid used in these experiments. This might account for the low amount of sulphur found in the relative experiments, but not for the great discrepancy in the two series of estimations.

As regards the relative therapeutical effects of sulphuric *versus* sulphurous acids, it might be said that the ultimate results would be the same because the sulphurous acid becomes gradually converted into the higher oxide. This is only true to a very limited extent; in fact, the sulphuric acid vapours are much more local in their effects, whilst the sulphurous acid is diffused at once through the apartment, and may be perceived, by virtue of its irritating effects upon the lungs, in any part of the room. It is probable that in the storage of delicate goods they would be much more likely to be injured by the sulphurous acid, and, *ergo*, by the 20-candle gas, than from the emanations from 16-candle gas. I am of opinion, also, that there is more sulphide of carbon present in ordinary gas than is generally stated, and that it escapes all the ordinary processes of estimation. I must, however, reserve this point for another communication.

As regards the Letheby's apparatus, it seems capable of performing many experiments having an important and useful bearing. Its great recommendation is that it submits the gas to a combustion similar to that which takes place in its daily use, and that, if more perfect combustion of the sulphur took place upon burning the gas with spongy platinum, as in Valentine's process,* it would not give the information we require in these special investigations.

The experiments embodied in this paper are not put forward as by any means complete, but they may be viewed as pioneers of a style of investigating which must be attended with some novel results, and must repay the experimenter. The presence of ammonia in the gas will determine the elimination of the sulphur as sulphuric acid.

A SINGULAR CASE OF CORROSION OF A TIN TANK.

By S. P. SHARPLES.

IN June, 1872, I received a letter from the Collins Company, of Collinsville, Conn., of which the following is an abstract :—

This company has a hotel building in this place, supplied with very good spring water, which is conducted through, say 100 feet of lead pipe, from the cement pipe main in the street, to a very large tank or reservoir on an upper floor in the hotel. From this tank water is distributed all over the house, through lead pipes. Water is continually running into the tank, and of course is freely drawn off to the various points. The tank is lined with what the plumber calls pure block-tin. We observe that the water deposits white streaks, at various levels, around on the lining. Enclosed we send you a specimen of the tin lining and the white deposits or powder.

A waste pipe, 9 feet long by 2 inches in diameter, is within the tank, and subject to the action of the water.

Is the white powder from lead or any corrosive metal ?

Subsequently they forwarded me specimens of the water taken from the spring, from the place where the lead pipe discharged into the tank, and from the place where it was drawn for the use in the house.

The water taken directly from the spring was examined, and gave 5·3 parts inorganic matter, and 2·5 parts organic matter, to the 100,000 parts of water.

The inorganic portion was mainly carbonate of lime, with a little sulphate of lime and chloride of sodium. The specimens of water drawn from the lead pipes were entirely free from even traces of that metal. The white powder referred to was found to be oxide of tin, with a mere trace of iron. I accordingly reported that I did not think any harm would arise from the use of the water,—

as the water was a pure one, and free from lead,—and that oxide of tin was not regarded as injurious.

On the 27th of March, 1874, the superintendent of the works again wrote as follows :—

" We enclose specimens of the lining of the tank which contained the water, the purity of which we were suspicious. We may be mistaken, but it does seem to us that the lining has been destroyed by the action of the water, in a most unusual manner. The tank lining has lasted only five years. There has been a free and ample circulation of fresh water constantly in use in the day time, at the hotel where our tank is located ; and yet, for some cause unaccountable to us, the lining (which is block-tin) is perfectly riddled by corrosion, and must be replaced by a new one of some kind."

In answer to further inquiries on my part, he forwarded another specimen of the water, and a large piece of the lining of the tank, and further wrote :—

" The water is collected at the spring, in a sheltered and ventilated reservoir, with cement lining, and is conducted therefrom in a large cement pipe through our main streets. House pipes of lead are attached all along."

The water from the end of the pipe, where it discharged into the tank, was again analysed, with the following results :—

Inorganic matter, 4·20 ; organic matter, 0·80 parts, in 100,000. Was perfectly free from nitrates ; and, as the analysis shows, was rather better than when first examined. The lining is commercial block-tin, containing less than 2 per cent of impurities.

Instances of corrosion of lead are not uncommon ; but I have failed, so far as I have investigated, to find a case parallel to this. Professor Chandler,* in an article on the use of tin-lined lead pipe, says, in speaking of tin-lined pipe : " Waters which take up one to two tenths a grain per gallon from lead pipe are not perceptibly affected by remaining for considerable lengths of time in the tin-lined pipes." And in another place, Mr. Cassamajor† states that tin is slightly more electro-negative than lead ; and that it at first starts of a feeble galvanic current, which serves to cover the lead with a coating of oxide, and then all action ceases.

Dr. Lankester‡ states, in regard to the tin-lined lead pipes : " I have tested these pipes with great care, and have exposed them to the action of water of various kinds. In no case have I discovered in the water the slightest trace of lead or tin. I have submitted the pipes to the action of distilled water, Thames water, water from artesian wells in London, and to water highly charged with organic matter ; and in no case, where these waters have been exposed to the usual reagents for detecting the presence of tin or lead, has the slightest quantity of these metals been detected."

Field‖ states that tin does not oxidise at ordinary temperatures in the air, and but very slightly in water, retaining its metallic lustre for a long time ; and, again, it is not sensibly affected by the combined presence of air and moisture.

This extensive corrosion of the metal seems, therefore, to be a hitherto unrecorded circumstances, tin being generally regarded as the least liable to change of all our common metals. The metal, as will be seen, is entirely eaten through in some places.

CORRESPONDENCE.

THE CHEMICAL SOCIETY.

To the Editor of the Chemical News.

SIR,—In CHEMICAL NEWS, vol. xxix., p. 285, a suggestion is made by " Equivalent " which no rational Fellow of the

* The best method for estimating the total amount of sulphur.

* *Am. Chem.*, vol. ii., p. 232.
† *Ibid.*, vol. i., p. 3.
‡ *Ibid.*, vol. ii., p. 27.
‖ " Watts' Dictionary," vol. v., pp. 603—4.

Chemical Society can approve of. The abstracts of papers from foreign sources now form the most valuable feature in the Journal, and have more than doubled its value ; and no one can grudge the increase in price consequent on this most important improvement.

"Equivalent" thinks that practical papers should be more encouraged than they are. I venture to say that a too great partiality is already shown to so-called practical papers, while theoretical research is suppressed and discouraged. While a paper made up of analyses of some impure substances or mixtures, which the author may have succeeded in producing for the first time on record, is almost certain of publication in the Chemical Society's Journal, the publishing committee show a most unjust and unwarrantable reluctance to publish theoretical papers read before the Society. Excepting the leader of chemistry in Britain, and one or two older chemists now on the wane, theoretical chemistry has no supporters or representatives in England.

By calling the attention of sensible men to the points on which "Equivalent" offers such valuable suggestions, his letter may prove not as useless as it would at first appear. —I am, &c.,

M. L.

Charlton, May 28, 1874.

THE CHEMICAL SOCIETY.

To the Editor of the Chemical News.

SIR,—Allow me, as a country Fellow of the Chemical Society, to protest against "Equivalent's" proposal to return to the old style of quarterly reports without abstracts. I feel sure that I shall express the feeling of most provincial members, when I say that the admirable Journal is one of the chief inducements to me to remain a member of a society the meetings of which I am never able to attend ; and though, in London, where access to foreign journals is comparatively easy, a chemist might do without such a help, in the country it has become almost indispensable.—I am, &c.,

H. R. P.

CHEMICAL EXAMINATION AND COMPARATIVE COMPOSITION OF SOME SPECIMENS OF PRESERVED MEAT.

To the Editor of the Chemical News.

SIR,—I have to answer the remarks of Mr. Ogilvie under the disadvantage of rural seclusion ; therefore he will pardon me if I do not refer to many printed authorities in substantiation of my remarks.

(2.) Under this paragraph Mr. Ogilvie fails to perceive the point of my reference to the term "fibrin or syntonine;" I think it will appear that my remarks were not irrelevant when I say that syntonine is the form of albumin which is obtained from muscle residue by the action of dilute acid, and not the residue left after treatment with water, alcohol, ether, &c. ; in substantiation I refer to Thudichum's "Chemical Physiology," page 36, where he says "This (syntonine) is the name of the solid part of the flesh tissues, the particular fibrine of flesh of Liebig, which, insoluble in water, can be extracted from the insoluble part of meat by dilute acids in large quantities ;" in fact, we may consider syntonine to hold a similar relationship to insoluble meat residues as gelatin does to osseine, *i.e.*, they are both formed by the processes used for the extraction.

(3.) I still hold that there is no justification for the statement that "fat is not only indispensable &c.," for Mr. Ogilvie says in his original paper, which I have not at hand, something to the effect that the fat present in the mutton is necessary for the repair of tissue. I do not say fat should be absent from our diet, but I hold that it is not

absolutely necessary, for many of the herbivora take but an infinitesimal portion in their food, but they convert starch and sugar to fat.

I hold, then, that it is not necessary, though advantageous, to ingest fat. The extract (*d*), quoted from Lehman's "Physiological Chemistry," is rather out of date now, and does not support Mr. Ogilvie, because it states "We cannot *believe* that fat is a mere incidental agent in all these processes, but we must *rather* regard it as of essential aid, &c." (the Italics are mine).

This doubting condition shows Lehman to have been uncertain of the truth of the statement, and does not say a word about it being necessary to ingest fat, therefore the fat for this purpose could have been formed afterwards from starchy bodies. Dr. Thudichum says (Chem. Physiol., p 45)—"Fat in tissue may originate in several ways ; it may have been eaten with the food, and after absorption have only been carried to the cells ; or it may be formed from sugar dextrine, and glykogen ; or lastly, it may owe its existence to the decomposition of albumen."

(6.) In this paragraph Mr. Ogilvie thinks that he has not fallen into error in comparing creatin with caffeine. I admitted in my former letter that chemically they had a resemblance, but what I objected to was, that creatin had been compared with caffeine in its physiological action : it has no parallel ; the one is an alkaloid of an active nature, the other a poison which has to be got out of the system as quickly as possible, and therefore it is indeed a great error to state that it is useful as a stimulant in meat extract.

(7.) I do not think that experiments with the individual constituents of a composition always yield satisfactory results ; nevertheless they should not remain untested ; but Mr. Ogilvie thinks that my advocacy of Bogoslowsky's experiments puts me in opposition to "nearly the entire medical faculty ;" it must be remembered that the medical faculty as an entire body gains its views of these substances, not from the individual experimental experience of its members, but from the few who choose to devote their time to the elucidation of natural phenomena.

Now there are many who have advocated the extract of meat as beneficial, and many who have condemned it, but these are few compared with the large number who make up the faculty and follow a leader.

In the capacity of medical officer to an asylum containing 2000 patients, I have had rare opportunities for making the "long-continued" observations, which, by the way, I consider to be more empirical than laboratory experiments ; and I have decided to give preference to a beef-tea freshly prepared from fresh beef, rather than to an extractive carnis of the kind under discussion.

The argument adduced by Mr. Ogilvie respecting the difference in physiological results between large and small doses of poisons is not apt: he compares urea, creatin, &c., to alcohol and caffeine, two known stimulant poisons, and says it is irrelevant to the subject to speak of their action when in excess ; I, however, only referred to the action of lactic acid in excess.

I may perhaps be allowed to compare urea and creatin to lead, a cumulative poison which in continued small doses produces decided symptoms, as will urea. It is well known that urea and creatin do not undergo decomposition in the body, but pass out unchanged after injection or ingestion ; but alcohol and caffeine are consumed, particularly the latter, as I hope to show conclusively in some experiments shortly to be published ; therefore, although small doses of alcohol and caffeine are oftentimes useful, small doses of urea or creatin must always be injurious. I fear the poorer classes in England have not yet found out how they may be benefited by the use of a cheap preserved meat : essentially abominable cooks, they have not succeeded in making palatable dishes, and are necessarily prejudiced against it, a condition of things to be deplored.

I regret Mr. Ogilvie should think my remarks unfounded and hypercritical, because it was my intention only to

discuss with him the points at issue, which I think is one of the most advantageous methods of obtaining the opinion of another, and not to raise harsh strictures.—I am, &c.,

S. W. MOORE.

Dover, June 20, 1874.

PRELIMINARY NOTICE.

To the Editor of the Chemical News.

SIR,—I have obtained the sulphur, chlorine, bromine, iodine, arsenic, some of the selenium and tellurium compounds, analogous to the nitro-prussides. A detailed paper will be published soon in the CHEMICAL NEWS.—I am, &c.,

T. D. CUTHILL.

Hornsey Road, Holloway,
July 1, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, May 11, 1874.

Interior Distribution of Magnetism in a Bundle of Several Plates.—M. Jamin.—The author studies the case of a bundle decomposed and recomposed, then a bundle formed of saturated plates. *En resumé*, (1) All the plates have the same magnetism, m. (2) The magnetism, M, of the bundle is equal to those of the plates, $M = mn$. (3) If n is small each plate keeps the magnetism which it had. (4) If n exceeds a certain number the surfaces are saturated; M reaches a constant limit, m decreases. (5) The limit of M depends only on the extent of the surfaces of the magnet.

General Ideas on the Mechanical Interpretation of the Physical and Chemical Properties of Bodies.—M. Ledieu.—The author's object is, methodically, to develop the hypothesis of atomic vibrations; deducing from them the laws of heat, and the new principles of thermo-dynamics and thermo-chemistry. The paper is hardly suited for abstraction.

Permanence of Intensity of the Sun's Calorific Radiation.—M. Duponchel.—(Extract from memoir) One cannot allow a complete diffusion of movement tending to bring the molecules of the universe to a final state of uniform vibration. As there are centres of diffusion, there must also be centres of concentration, and all tends to show that these centres are the same; that, in particular, there is not loss of *vis viva* in the solar radiation but circulation—a closed circuit bringing back to starting-point the *vis viva* emitted. There cannot be a point of vibration forcing the ether out from it without an attraction of ether to fill the vacuum that tends to be produced. This conclusion is supported by various facts in physics. It is deducible from the readily ascertained truth, that the *vis viva* feeding the solar flux is really very small. The author cites as an incontestable proof the frigorific effect which the passage of Jupiter at the perihelion, coinciding with the periodic return of the solar spots, has on the temperature of the photosphere. When a planet passes the perihelion, it acquires an excess of *vis viva* of translation, which must be compensated by an equivalent loss of *vis viva* at other points. This temporary gain by the planet can come only from three sources—the internal *vis viva* or calorific force of the planet; the similar calorific force of the sun; and, lastly, the movement of translation of the sun and all the planets in space. The last is doubtless the most important, but the two others co-operate. In other terms, the planet then acts as a brake retarding the proper motion of the sun, but at the same time it draws upon its own heat; a cooling limited to its atmosphere and its solid surface, which induces temporary absorption of the calorific flux sent out from the sun. But this last absorption is necessarily limited to a fraction, greater or less, of the flux perceived during the period of absorption, equal to a fourth of the total revolution. For Jupiter, in particular, the total quantity of heat thus derived is, then, inferior to what the planet receives in two years and eight months; a quantity nearly equal to what the surface of the sun emits in one-sixth of a second. A fraction of this small quantity, absorbed in perihelion, restored in aphelion, produces, then, a very considerable calorific effect in the calorific state of the photosphere, the total force of which, referred to the intensity of the current, cannot therefore be figured either by thousands of centuries, or by years, but by minutes, and perhaps by seconds or fractions of a second. This frigorific effect occurs with all the planets, and, in the case of our earth in particular, it may explain the well ascertained inferiority of temperature of the Southern Hemisphere, the summer of which coincides precisely with the solstice of the perihelion.

Memoir on the Determination of True Simple Bodies by the Actions of Battery Currents in the Voltameter.—M. Martin.—(Extract) The author thinks he is able to demonstrate—(1) That the two electricities are not forces but imponderable bodies, having powerful and different chemical affinities, and that they do not act as physical forces, but, through a double chemical action, on the elements of water, transforming them into gas. (2) That water does not contain, as commonly supposed, two condensed gases which have only to be dissociated to be reproduced, but that the simple bodies H and O are its elements. (3) That the two gases whose combination produces water are compound bodies, formed by the chemical unison of the simple body oxygen with positive electricity, and the union of simple hydrogen with negative electricity, the combination of these gases giving two binary bodies, water and caloric. (4) That the currents of the battery do not pass through the acidulated liquids, and do not cause transport of elements, but that the two electricities simply reach the electrodes, and these unite with the elements of water, transforming them into hydrogen at the negative pole, and oxygen at the positive. M. Martin calls the negative electricity *electrile*, with the symbol El; and the positive electricity *etherile*, with Et for symbol. The formulæ of the two combined gases are thus HEl for hydrogen, and OEt for oxygen. He applies his theory to various electrical phenomena.

Mechanical Employment of Heat.—M. West.—(Extract from memoir). The author finds that the theoretical return for fuel in an air engine is superior to the return in certain steam engines in the proportion of 4·41 to 1. Hence the replacing of steam by air may be only partial, and yet present considerable advantages.

Study on the Properties of Explosive Substances.—M. Abel.—(Conclusion of third memoir

Absolute Magnetic Declinations Observed on the Coast of the Adriatic Sea.—M. Diamilla Miller.—The author here compares the calculated results with those of observation, and finds close agreement. He has been authorised by the Italian Minister of Marine to construct maps of the isogonal lines of Italian seas.

Observations Relative to the Memoir of MM. Crocé Spinelli and Sivel on their Ascent of March 22, 1874.—M. Lantique.—The author finds his own observations, with regard to the mistral, &c., confirmed.

Albumenoid Bodies.—M. A. Commaille.—The author has all along denied that the albumenoids could be regarded as protein, or any other single substance associated with bases or salts. Along with Millon he has shown—as is

admitted by Berzelius, Quevenne, &c.—that milk contains two caseins and an albumen, which he has named *lactalbumen*; and also another principle which, in conjunction with Millon, he has named *lactoprotein*. Is not this the *galactozymase* of Béchamp? The author has always been of opinion that lactoprotein plays an important part in the spontaneous coagulation of milk. He has shown (*Moniteur Scientifique*, 1866, p. 897) that the albumenoids do not all combine with the same weight of platinum, which—as well as the rotatory power—may prove that they are specifically distinct. The platinic compounds tend to show that the albumens of animal origin take up, in general, more metal than those extracted from vegetables. Physiologically speaking, it is important to know that the albumen of milk, and that of the liquid of ascites, are no other than the albumen of blood-serum (Pt = 8·50 per cent) not having undergone any modication. This identity has been already admitted by Hoppe-Seyler. In the blood itself the fibrin is merely albumen dissolved in serum, having taken another form, whilst the albumen of the red globules departs from this standard, and approximates closely to the albumen dissolved in the liquid which moistens the cerebral substance and the muscles, and furnishes the albumen of pathological urines. (Pt = 10·50 to 11 per cent.) Vitelline resembles coagulated white of egg (Pt = 8 per cent) whilst the casein of milk approaches certain principles abundantly diffused in the vegetable world, and known as vegetable casein (Pt = 6·50 per cent), almondin, fibrin of gluten, &c. The author, along with Millon, regards the albumenoids as quaternary bodies, which may be represented as amids of leucin (capronamic acid) and of tyrosin; which is, according to him, the amide of Gerhardt's acetobenzoic acid, $C_{18}H_{11}O_6N$, a homologue of anisamic acid, $C_{16}H_9O_6N$.

Theory of the Formation of Nitre in Peru.—Antony Guyard. The author supposes that there have been sulphuric, hydrochloric, boric, nitric, and iodic epochs.

Coniferin; Artificial Formation of the Aromatic Principle of Vanilla.—F. Tiemann and W. Haarman.—

Reimann's Farber Zeitung, No. 22, 1874.

Karan's Pigment.—This colour, offered to dyers at 15s. a pound, appears in two modifications. The one, warranted to dye a red on sixty times its weight of wool, consists of ground cochineal mixed with a preparation of tin and with oil of turpentine. The other variety, which is to supersede the aniline violets, is solid extract of logwood, pulverised, and mixed with a black powder, probably wood charcoal. It yields the well known flat logwood purple. Both these preparations are, of course, far from being worth the price at which they are offered.

Receipts follow for a black on cotton-wool; a red with artificial alizarin on cotton; a yellow on garments (cotton warps); directions for destroying the cotton in mixed rags; for dyeing woollen and mixed doubles; for dyeing woollen piece goods black, with a white list; for printing aniline colours on wool; and for dyeing woollen yarns a reddish drap.

Davy's Artificial Ivory.—This substance, being made by the action of a mixture of sulphuric and nitric acids upon cotton and linen rags, must consist in part of nitrocellulose, better known as gun-cotton. Articles made of it may, therefore, prove dangerous under a variety of possible circumstances.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 6, April 13, 1874.

Guanovulit—a New Mineral Found in the Birds' Eggs of Peruvian Guano.—F. Wibel.—The eggs in question belong to the genera *Aptenodytes, Pelecanus, Carbo*, &c. One of these contained a splendid crystalline body of a yellowish white colour and silky lustre. Its

hardness is 2, its sp. gr. 2·33 to 2·65. It dissolves in water, forming a yellowish saline liquid, and leaving a slight residue. Dried at 100° it gave—

Loss on ignition	36·10

Deduct—

Sulphuric acid = ...	24·08
Water, ammonia, and sal-ammoniac = ... }	10·91
	34·92

Remains—

Organic matter	1·11
Insoluble matter	0·26
Chlorine .. .. ..)	0·58
Total sulphuric acid (SO_3) ..	48·43
Potash	34·76
Ammonia	3·46
Lime, phosphoric acid, soda, &c.	1·33

Excluding impurities we obtain the following composition

Water	9·82
Sulphuric acid (SO_3)	49·60
Potash	34·27
Ammonia	5·42
	99·11

agreeing with the formula—

$$(H_4N)_2SO_4 + 2K_2SO_4 + 3KHSO_4 + 4aq.$$

Of known minerals it approaches most closely to the lecontite of Taylor, and the guanapite of Shephard.

New Method of Formation of Diphenylen Oxide. —C. Graebe.—Kekulé has shown that the lead compound of phenyl-sulph-hydrate when heated yields sulphophenyl and sulphide of lead. The behaviour of phenol lead, under the same circumstances, has been examined by the author, who thus obtained diphenylen oxide, and a small quantity of a body not yet examined.

Action of Lead Oxide on Phenol at Elevated Temperatures.—Arno Behr and W. A. van Dorp.—Phenol conducted over oxide of lead, moderately heated, yields a distillate, which on treatment with potash yields a solid body. On extraction with alcohol and cooling they obtained crystalline leaflets, which are best purified by redistillation in watery vapour, in which they volatilise. They exhibit all the properties of diphenylen oxide.

Dibrom- and Dioxy-malonic Acids.—W. Petrieff.— The author has investigated the formation of bibrommalonic acid, and examined its ammonia, silver, lime, and baryta salts.

Promiscuous Communications from the Laboratory of the London Institution.—H. E. Armstrong.—These comprise the preparation of the haloid derivatives of the nitrophenol-sulphonic acids; the production of bromphenol from bromanilin; notes on the cresol of coal-tar; on the action of formiate of soda on the benzol-disulphonate of potash; and on the naphthyl sulphides.

Remarkable Occurrence of Humic Acid.—Th. Lettenmayer and C. Liebermann.—A piece of beech-wood was found covered with a black brittle layer of resin. This was easily soluble in cold water, the solution having an alkaline reaction. On the addition of a mineral acid an organic acid was deposited in rust-coloured flakes, containing a trace of nitrogen, 53·6 per cent of carbon, and 4·9 per cent of hydrogen.

Addition-Products of Hypochlorous Acid with the Allyl Compounds.—Louis Henry.—Not adapted for abstraction.

Conversion of Dinitro-benzol into Dibrom-benzol. —C. Wurster and U. Grubenmann.—The title of this paper gives a sufficient idea of its contents.

Azo Compounds.—W. Michler.—The compounds examined are biazoxy-benzoic acid and nitro-biazoxy-benzoic acid, with its behaviour in contact with tin and hydrochloric acid, and isobiazoxy-benzoic acid.

Æthyl-nitrolic Acid.—V. Meyer.—The author describes the formation of this acid, its preparation, its salts, its behaviour when heated, when treated with nascent hydrogen, and with sulphuric acid.

"In Defence."—J. Moritz.—Under this singular title we find a controversial note referring to Brefeld's paper, *Berichte*, vii., No. 5.

Nitro-oxysulpho-benzidanilid and Diamido-oxy-sulpho-benzid.—J. Annaheim.—The former compound consists of—

Carbon	58·77
Hydrogen	3·67
Nitrogen	11·42
Sulphur	6·53
Oxygen	19·59

It crystallises from solution in aniline in splendid red orthorhombic prismatic crystals (∞ P,OP), and is permanent, *per se*; but if boiled with water, alcohol, ether, or benzol it decomposes with separation of aniline. The author has examined the hydriodate, hydrochlorate, and sulphate of the latter body. He mentions a peculiar behaviour of the amid compound with nitrous acid. If the hydrochlorate or the sulphate, in an acidified aqueous solution, is treated with nitrite of potash the liquid turns reddish, and a splendid scarlet body is deposited, soluble in ammonia with a deep red colour, and re-precipitable by acids. It deflagrates if heated.

On Orcin.—P. Weselsky.—Reserved for insertion in full.

On Phloroglucin.—R. Benedikt.—The action of nitrous acid upon phloroglucin does not lead, or at least not invariably, to nitrogenous compounds, as is the case with orcin and resorcin, but there is formed a non-nitrogenous dark brown colouring matter with a green metallic lustre, soluble in alkalies and ammonia with an intense colour. Its composition agrees with the formula $C_{12}H_8O_5$. The author gives it the name phlorein.

On Bixin.—Carl Etti.—A mere preliminary announcement.

Synthesis of Dicyan-diamidin.—E. Baumann.—A salt of guanidin is fused with urea, and heated for a short time. When cold the mass is dissolved in water, when dicyan-diamidin is found in the solution.

Communications from the Greifswold Laboratory.—H. Limpricht.—These communications refer to metatoluidin, several of the salts of which have been examined; meta-brom-ortho-sulpho-toluylic acid with its salts; nitro-meta-brom-ortho-sulpho-toluylic acid and its salts; and the nitro-diazo compounds.

Multiples in the Chemical Development of Heat.—Julius Thomsen.—The author shows that analogous chemical processes are accompanied by developments of heat, which are either multiples of common constants, or whose differences are found to be such multiples.

Communications from the Laboratory of Gottingen University.—H. Hübner.—Notices of the iodo-nitrophenols, of isomeric benzo-nitranilids and their different behaviour with nitrogen, and of toluylen-diamin-sulpho acid and its salts.

Itaconic, Citraconic, and Mesaconic Acids.—G. A. Barbaglia.—By treating itaconic acid with anhydrous hydrocyanic acid the author forms the acids above-mentioned.

Action of Chlorine upon Aceton.—G. A. Barbaglia.—The author obtained in this manner both mono-chlor-aceton and dichlor-aceton.

Correspondence from Lund.—C. W. Blomstrand.—E. Berglund has examined the double salts of sulphurous acid, especially the cobalti-sulphites. A. Atterberg has published a dissertation on the glucinium compounds. Nordenskiöld has investigated the crystalline forms of cerite. O. Pettersson has examined the molecular volumes of certain series of isomorphous salts. O. N. Pahl has been engaged with the pyrophosphates. A. Morblad

describes apparatus for the production of constant and prolonged currents of gases, and a syphon giving a constant current.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in evaporating and concentrating solutions of caustic soda, potash, and their salts, acid liquors occurring in the manufacture of oxalic acid, and also gelatine. Richard Samuel Dale and John Dale, chemists, Manchester. October 2, 1873.—No. 3191. In the manufacture of caustic soda, caustic potash, or mixtures of the same and other substances, from the solutions of which salts are deposited in their evaporation and concentration, much wear and tear of plant and loss of time is entailed by the process now usually carried on. Ordinary steam-boilers or other suitable vessels are used, from which the steam produced in the evaporation shall be rapidly conducted away by means of vacuum-pumps or other suitable means for producing a vacuum. These boilers may either be heated with fire or steam, but the latter is preferred, and is supplied by means of a series of tubes in connection with a large steam-chest placed inside the boiler or vessel used for the evaporation. The above mode of treatment is found especially applicable and advantageous in the manufacture of oxalic acid, where the solutions of the acid require to be kept at a low temperature to provide against decomposition; but in this case it is necessary that the process must be carried on in leaden vessels. This process will also be found most advantageous in the manufacture of glue and size (which it is absolutely requisite should be maintained at a low temperature during concentration), as also in the evaporation and concentration of the chlorides of sodium and potassium and other salts of the same.

A new or improved mode of cleaning or purifying and sweetening butter scrappings and rancid or decayed butter. William McDonnell and Charles McDonnell, Limerick, Ireland. October 6, 1873.—No. 3233 According to this invention, dirty butter or butter "scrappings" are melted and churned with milk or butter-milk, whereby the original qualities are recovered.

Improvements in metallic alloys. Henry Hahn, Lombard Street, London. (A communication from Jacob Ernst Jacoby, Hamburg-on-the-Heights, Germany). October 7, 1873.—No. 3246. This invention has for its object improvements in the composition of metallic alloys applicable to various useful purposes, such as reducing friction in bearings and other parts of machinery, resisting oxidation, being also comparatively cheap and economical. Metallic alloys made according to this invention consist of from 70 to 73 per cent of copper, from 9 to 11 per cent of tin, from 15 to 20 per cent of lead, and from 0·05 to 1 per cent of zinc.

Improvements in the treatment and compounding of cast-iron with other metals or materials containing such metals while in a molten state. George Gordon de Luna Byron, Chancery Lane, Middlesex. (A communication from William Mernorice Arnold, New York). October 7, 1873.—No. 3247. The alloying of cast-iron in its molten state with copper, tin, zinc, manganese, and antimony. The compound metals are melted in a crucible, and mixed with the cast-iron, removing the oxides, sulphur, and phosphorus, and reducing the carbon, electrophying and galvanising the iron in a molten state. The best proportions for common grey iron are as follows:—Copper, one (1) pound; tin, one-half ($\frac{1}{2}$) pound; zinc, three (3) pounds; manganese, one-quarter ($\frac{1}{4}$) pound; antimony, for hardening without chilling, from $\frac{1}{4}$ to $\frac{1}{2}$ pound to each hundred pounds of iron.

Improvements in apparatus for the manufacture of chlorine. Henry Deacon, Appleton House, Widnes, Lancaster. October 7, 1873.—No. 3253. In the production of chlorine by means of heated hydrochloric acid and of atmospheric air, brought into contact at an elevated temperature with what I have termed a decomposing material, viz., porous brick, clay, or other inert matter, impregnated with sulphate of copper or with a mixture of sulphate of copper and sulphate of soda or otherwise, a further amount of heat is emitted during such decomposition, and the object of this invention is to utilise and make available this emitted heat in assisting the preliminary heating of the gases.

Improvements in the manufacture of iron and steel. Stanislas Louis Delalot, chemist, Southampton Buildings, Holborn, Middlesex. October 9, 1873.—No. 3268. The features of novelty of this invention consist in mixing nickel or cobalt, or a mixture of both, with iron or steel in certain proportions, by which it is rendered proof against rust by exposure to the atmosphere, water, or other oxidising influences. Cast-iron thus treated can be converted into wrought-iron and steel by the usual methods, and is equal in quality to iron and steel as heretofore manufactured.

NOTES AND QUERIES.

Recovered Animal and Vegetable Oils and Grease.—Can you or any of your valued correspondents kindly inform me, through the medium of the CHEMICAL NEWS, how to bleach and refine recovered animal and vegetable oils and grease, also the stearine produced from the same? Having a large quantity on hand, I shall be very much obliged for this information.—AN OIL-REFINER.

TO CORRESPONDENTS.

W. B.—Your query is only suitable for our advertisement pages.

THE CHEMICAL NEWS.

VOL. XXX. No. 763.

THE COMMITTEE ON ADULTERATION.

In returning to the consideration of the statements made before this Committee, we must remind our readers that the Adulteration Act, as at present in force, requires that public analysts should possess "sufficient medical, chemical, and microscopical knowledge." Partly in consequence of this stipulation, and partly from the old superstition still prevalent in England, that chemistry has some especial and exclusive connection with the healing art, not a few of the analysts appointed under the Act are practising medical men. The gentlemen examined before the Committee were asked whether, in their opinion, medical knowledge was a necessary qualification for a public analyst. With the exception of Dr. Tidy all replied in the negative. We quite agree with the majority. No amount of medical—as distinct from chemical—knowledge can render the slightest aid in the essential part of an analyst's duty, the detection of adulterations in articles of food. When impurities are discovered a second question may certainly arise as to their probable effect upon public health; but on this subject sound information has been so widely circulated that every professional chemist, nay, almost every man of decent education, can give a satisfactory answer. We are perfectly aware that many of the most eminent chemists have been originally educated for the medical profession. But how any one man can be, at the same time, a successful medical practitioner and a trustworthy chemical analyst, we are unable to see. For the most gifted of us there are only twenty-four hours in the day. If a division of labour is found essential in ordinary trades, is it less necessary in case of professions which make such vast and continually growing demands upon time and attention? Nay, it might be argued that the habits of thought developed by the practice of medicine are not precisely those which lead to success in the rigorously exact sphere of chemical research. Hence, far from demanding "medical" knowledge from the public analyst, we should think an actually practising medical man disqualified for such a position.

The number of disputed cases which have come before the courts, and have given rise to some amount of profane comment in non-professional journals, naturally led to the question of a reference whose decision should be final. But when we heard the Inland Revenue Laboratory at Somerset House suggested as the ultimate court of appeal we were disposed to think that the proposal was a joke intended for the columns of one of our comic contemporaries. Among the public analysts, and among those chemists who might be called to give evidence in defence of an accused person, there are men who have won a world-wide reputation by years of laborious and successful research. We fully endorse the statement that such men are more fit to revise the results of the Somerset House Laboratory than to bow to its decisions. As far as we can judge the award of the Revenue analysts would not be accepted by any first-rate chemist.

We feel certain that Dr. Voelcker would protest if his analysis of a sample of coprolites or superphosphate were to be rejected as inaccurate and overruled on such authority.

We feel bound to add that we see no reason for supposing that this most unhappy and ill-judged scheme has emanated from the Inland Revenue chemists, or has even received their sanction, and we cannot help sympathising with them on the embarrassing position in which they have found themselves so unexpectedly placed.

We have already made mention of Mr. Allen's rival— and infinitely more practical—project. This gentleman proposes the formation of an independent body of referees, to be elected annually by the public analysts themselves. On the details of this scheme considerable variety of opinion may prevail. But we think it deserving of support because it is—or rather it would be—the first formal and official step towards the definite professional organisation of analytical and consulting chemists. We have, from time to time, pointed out the necessity for such an organisation. We believe it is demanded alike in the interests of the public and of chemists themselves. It is needful, on the one hand, to exclude incompetent and dishonourable men, and on the other to raise and defend the *status* of the profession, and prevent its legitimate sphere from being encroached upon by outsiders. But such an organisation must, as in the analogous cases of the Pharmaceutical Society, of the Institute of Civil Engineers, the Royal College of Surgeons, &c., come from within. The Analytical and Consulting Chemists of England must win the right of deciding who shall be admitted into their body, who shall have the right of practising, and whom they will recognise as duly qualified. To so desirable a consummation we believe that Mr. Allen's suggestion may be made to serve as the first step, and we therefore would beg, on its behalf, the especial consideration of our readers. It obviously contains not merely a provision for deciding disputed cases, but a key to another difficulty with which the Committee was to some extent engaged, and to which it will be our duty to return,—namely, the appointment of the public analysts themselves.

We are not about to come forward as the general and indiscriminating advocate of these gentlemen. Class laudations are no less injudicious than class censures. Like other bodies of men, however selected and appointed, they vary in competence for the duties they have undertaken. But who—especially in case of a novelty like the working of the Adulteration Act—could expect anything else? The public analysts have undertaken a task far from easy; they have been but very sparingly supported by public opinion, and have been keenly scrutinised by parties interested in fraudulent practices.

The question as to what constitutes adulteration, and what therefore should meet with repression and punishment, seems still open. If we might venture to suggest, we would recommend a gradually increasing stringency. Let us first wage war against the grosser evils, and as they become rarer let us turn our attention to those of a less formidable character. Dishonest tradesmen have quietly and perseveringly educated the public palate down to "fortified" wines, and chicoried coffee, and farinised chocolate, and brilliantly green jams and pickles. We have got to reverse the process, and if we proceed too rashly we may not only lose the support of public opinion, but find it enlisted against us.

Why, we may here ask, should the law confine its attention to articles of diet? The man who sells us a blanket got up with a deliquescent salt, like chloride of magnesium, imperils our health just as decidedly as if he had put amylic or petroleum products in our wine, or red-lead in our chocolate. Is it just that he should altogether escape?

ON THE FORCES CAUSED BY EVAPORATION FROM AND CONDENSATION AT A SURFACE.*

By Prof. OSBORNE REYNOLDS, of Owens College, Manchester.

It has been noticed by several philosophers, and particularly by Mr. Crookes, that, under certain circumstances, hot bodies appear to repel and cold ones to attract other bodies. It is my object in this paper to point out and to describe experiments to prove that these effects are the results of evaporation and condensation; and that they

* A Paper read before the Royal Society, June 18, 1874.

are valuable evidence of the truth of the kinetic theory of gas, viz., that gas consists of separate molecules moving at great velocities.

The experiments of which the explanation will be given were as follows :—

A light stem of glass, with pith-balls on its ends, was suspended by a silk thread in a glass flask, so that the balls were nearly at the same level. Some water was then put in the flask, and boiled until all the air was driven out of the flask, which was then corked and allowed to cool. When cold there was a partial vacuum in it, the gauge showing from ½ to ¾ of an inch pressure.

It was now found that when the flame of a lamp was brought near to the flask, the pith-ball which was nearest the flame was driven away, and that with a piece of ice the pith was attracted.

This experiment was repeated under a variety of circumstances, in different flasks and with different balances, the stem being sometimes of glass and sometimes of platinum : the results, however, were the same in all cases, except such variations as I am about to describe.

The pith-balls were more sensitive to the heat and cold when the flask was cold and the tension within it low, but the effect was perceptible until the gauge showed about an inch, and even after that the ice would attract the ball.

The reason why the repulsion from heat was not apparent at greater tensions was clearly due to the convective currents which the heat generated within the flask. When there was enough vapour these currents carried the pith with them ; they were, in fact, then sufficient to overcome the forces which otherwise moved the pith. This was shown by the fact that when the bar was not quite level, so that one ball was higher than the other, the currents affected them in different degrees; also that a different effect could be produced by raising or lowering the position of the flame.

The condition of the pith also perceptibly affected the sensitiveness of the balls. When a piece of ice was placed against the side of the glass, the nearest of the pith-balls would be drawn towards the ice, and would eventually stop opposite to it. If allowed to remain in this condition for some time, the vapour would condense on the ball near the ice, while the other ball would become dry (this would be seen to be the case, and was also shown by the tipping of the balance, that ball against the ice gradually getting lower). It was then found, when the ice was removed, that the dry ball was insensible to the heat, or nearly so, while that ball which had been opposite to the ice was more than ordinarily sensitive.

If the flask were dry and the tension of the vapour reduced with the pump until the gauge showed ⅜ of an inch, then, although purely steam, it was not in a saturated condition, and the pith-balls which were dry were no longer sensitive to the lamp, although they would still approach the ice.

From these last two facts it appears as though a certain amount of moisture on the balls was necessary to render them sensitive to the heat.

In order that these results might be obtained, it was necessary that the vapour should be free from air. If a small quantity of air was present, although not enough to appear in the gauge, the effects rapidly diminished, particularly that of the ice, until the convection currents had it all their own way. This agrees with the fact that the presence of a small quantity of air in steam greatly retards condensation, and even evaporation.

With a dry flask and an air-vacuum neither the lamp nor the ice produced their effects; the convection currents reigned supreme, even when the gauge was as low as ¼ inch. Under these circumstances the lamp generally attracted the balls and the ice repelled them,—*i.e.*, the currents carried them towards the lamp and from the ice ; but by placing the lamp or ice very low the reverse effects could be obtained, which goes to prove that they were the effects of the currents of air.

These experiments appear to show that evaporation

from a surface is attended with a force tending to drive the surface back, and condensation with a force tending to draw the surface forward. These effects admit of explanation, although not quite as simply as may at first sight appear.

It seems easy to conceive that when vapour is driven off from a body there must be a certain reaction or recoil on the part of the body; Hiero's engine acts on this principle. Or if a sheet of damp paper be held before the fire, from that side which is opposite to the fire, a stream of vapour will be drawn off towards the fire with a perceptible velocity, and therefore we can readily conceive that there must be a corresponding reaction, and that the paper will be forced back with a force equal to that which urges the vapour forwards. And, in a similar way, whenever condensation goes on at a surface it must diminish the pressure at the surface, and thus draw the surface forwards.

It is not, however, wholly, or even chiefly, such visible motions as these that afford an explanation of the phenomena just described. If the only forces were those which result from the perceptible motion they would be insensible, except when the heat on the surface was sufficiently intense to drive the vapour off with considerable velocity. This, indeed, might be the case if vapour had no particles, and was what it appears to be—a homogeneous elastic medium ; and if, in changing from liquid into gas, the expansion took place gradually, so that the only velocity acquired by the vapour was that necessary to allow its replacing that which it forces before it, and giving place to that which follows.

But, although it appears to have escaped notice so far, it follows as a direct consequence of the *kinetic* theory of gases that whenever evaporation takes place from the surface of a solid body or a liquid, it must be attended with a reactionary force equivalent to an increase of pressure on the surface, and which force is quite independent of the perceptible motion of the vapour. Also condensation must be attended with a force equivalent to a diminution of the gaseous pressure over the condensing surface, and likewise independent of the visible motion of the vapour. This may be shown to be the case as follows :—

According to the kinetic theory the molecules which constitute the gas are in rapid motion, and the pressure which the gas exerts against the bounding surfaces is due to the successive impulses of these molecules, whose course directs them against the surface, from which they rebound with unimpaired velocity. According to this theory, therefore, whenever a molecule of liquid leaves the surface, henceforth to become a molecule of gas, it must leave it with a velocity equal to that with which the other particles of gas rebound,—that is to say, instead of being just detached and quietly passing off into the gas, it must be shot off with a velocity greater than that of a cannon-ball. Whatever may be the nature of the forces which give it the velocity, and which consume the latent heat in doing so, it is certain, from the principle of conservation of momentum, that they must react on the surface with a force equal to that exerted on the molecule, just as the pressure of the powder on the breech is the same as on the shot.

The impulse on the surface, therefore, from each molecule which is driven off by evaporation must be equal to that caused by the rebound of one of the reflected molecules (supposing all the molecules to be of the same size), —that is to say, since the force of rebound will be equal to that of stopping, the impulse from a particle driven off by evaporation will be half the impulse received from the stopping and reflection of a particle of the gas. Thus the effect of evaporation will be to increase the number of impulses on the surface ; and although each of the new impulses will only be half as effective as the ordinary ones, they will add to the pressure.

In the same way, whenever a molecule of gas comes up to a surface, and instead of rebounding is caught and re-

tained by the surface, and is thus condensed into a molecule of liquid, the impulse which it will thus impart to the surface will only be one-half as great as if it had rebounded. Hence condensation will reduce the magnitude of some of the impulses, and therefore will reduce the pressure on the condensing surface.

For instance, if there were two surfaces in the same vapour, one of which was dry and the other evaporating, then the pressure would be greater on the moist surface than on that which was dry. And again, if one of the surfaces was dry and the other condensing, then the pressure would be greater on the dry surface than on that which was condensing. Hence, if the opposite sides of a pith-ball in vapour were in such different conditions, the ball would be forced towards the colder side.

These effects may be expressed more definitely as follows :—

Let v be the velocity with which the molecules of the vapour move,

p the pressure on a unit of surface,

d the weight of a unit of volume of the vapour,

w the weight of liquid evaporated or condensed in a second;

then the weight of vapour which actually strikes the unit of dry surface in a second will be—

$$= \frac{dv}{6};$$

and the pressure p will be given by—

$$p = 2\frac{dv^2}{6g}; *$$

and f, the force arising from evaporation, will be given by—

$$f = \frac{wv}{g};$$

therefore—

$$f = w\sqrt{\frac{3p}{gd}}.$$

Thus we have an expression for the force in terms of the quantity of water evaporated and the ratio of the pressure to the density of the vapour. And if the heat necessary to evaporate the liquid (the latent heat) is known, we can find the force which would result from a given expenditure of heat.

Applying these results to steam, we find that at a temperature of 60° the evaporation of 1 lb. of water from a surface would be sufficient to maintain a force of 65 lbs. for one second.

It is also important to notice this force will be proportional to the square root of the absolute temperature, and consequently will be approximately constant between temperatures of 32° and 212°.

If we take mercury instead of water, we find that the force is only 6 lbs. instead of 65; but the latent heat of mercury is only $\frac{1}{30}$ that of water, so that the same expenditure of heat would maintain nearly three times as great a force.

It seems, therefore, that in this way we can give a satisfactory explanation of the experiments previously described. When the radiated heat from the lamp falls on the pith its temperature will rise, and any moisture on it will begin to evaporate, and to drive the pith from the lamp. The evaporation will be greatest on that ball which is nearest to the lamp; therefore this ball will be driven away until the force on the other becomes equal, after which the balls will come to rest, unless momentum carries them further. On the other hand, when a piece of ice is brought near, the temperature of the pith will be reduced, and it will condense the vapour and be drawn towards the ice.

It seems to me that the same explanation may be given

* See Maxwell's " Theory of Heat," p. 294.

of Mr. Crookes's experiments; for, although my experiments were made on water and at comparatively high pressures, they were in reality undertaken to verify the explanation as I have given it. I used water in the hope of finding (as I have found) that in a condensable vapour the results could be obtained with a greater density of vapour (with a much less perfect vacuum), the effect being a consequence of the saturated condition of the vapour rather than of the perfection of the vacuum.

Mr. Crookes only obtained his results when his vacuum was nearly as perfect as the Sprengel pump would make it. Up to this point he had nothing but the inverse effects, viz., attraction with heat and repulsion with cold. About the cause of these he seems to be doubtful; but I venture to think that they may be entirely explained by the expansion of the surrounding gas or vapour and the consequent convection currents. It must be remembered that whenever the air about a ball is expanded, and thus rendered lighter by heat, it will exercise less supporting or floating power on the ball, which will therefore tend to sink, which tendency will be in opposition to the lifting of the ascending current, and it will depend on the shape and thickness of the ball whether it will rise or fall when in an ascending current of heated gas.

The reason why Mr. Crookes did not obtain the same results with a less perfect vacuum, was because he had then too large a proportion of air or non-condensing gas mixed with the vapour, which also was not in a state of saturation. In his experiments the condensable vapour was that of mercury, or something which required a still higher temperature, and it was necessary that the vacuum should be very perfect for such vapour to be anything like pure and in a saturated condition. As soon, however, as this state of perfection was reached, then the effects were more apparent than in the corresponding case of water. This agrees well with the explanation; for, as previously shown, the effect of mercury would for the same quantity of heat be three times as great as that of water; and besides this, the perfect state of the vacuum would allow the pith (or whatever the ball might be) to move much more freely than when in the vapour of water at a considerable tension.

Of course this reasoning is not confined to mercury and water; any gas which is condensed or absorbed by the balls when cold in greater quantities than when warm would give the same results; and as this property appears to belong to all gases, it is only a question of bringing the vacuum to the right degree of tension.

There was one fact connected with Mr. Crookes's experiments which, independently of the previous considerations, led me to the conclusion that the result was due to the heating of the pith, and was not a direct result of the radiated heat.

In one of the experiments exhibited at the *soirée* of the Royal Society, a candle was placed close to a flask containing a bar of pith suspended from the middle; at first the only thing to notice was that the pith was oscillating considerably under the action of the candle; each end of the bar alternately approached and receded, showing that the candle exercised an influence similar to that which might have been exercised by the torsion of the thread had this been stiff. After a few minutes' observation, however, it became evident that the oscillations continued instead of gradually diminishing, as one naturally expected them to do; and more than this, they actually increased until one end of the bar passed the light, after which it seemed quieter for a little, though the oscillations again increased until it again passed the light. As a great many people and lights were moving about, it seemed possible that this might be due to external disturbance, and so its full importance did not strike me. Afterwards, however, I saw that it was only to be explained on the ground of the force being connected with the temperature of the pith. During part of its swing one end of the pith must be increasing in temperature, and during the other part cooling. And it is easily seen that the ends will not be hottest when

nearest the light, or coldest when farthest away; they will acquire heat for some time after they have begun to recede, and lose it after they have begun to approach. There will, in fact, be a certain lagging in the effect of the heat on the pith, like that which is apparent in the action of the sun on a comet, which causes the comet to be grandest after after it has passed its perihelion. From this cause it is easy to see that the mean temperature of the ends will be greater during the time they are retiring than while approaching, and hence the driving force on that end which is leaving will, on the whole, more than balance the retarding force on that which is approaching; and the result will be an acceleration, so that the bar will swing further each time until it passes the candle, after which the hot side of the bar will be opposite to the light, and will for a time tend to counteract its effect, so that the bar will for a time be quieter. This fact is independent evidence as to the nature of the force; and although it does not show it to be evaporation, it shows that it is force depending on the temperature of the pith, and that it is not a direct result of radiation from the candle.

Since writing the above paper, it has occurred to me that, according to the kinetic theory, a somewhat similar effect to that of evaporation must result whenever heat is communicated from a hot surface to gas.

The particles which impinge on the surface will rebound with a greater velocity than that with which they approached, and consequently the effect of the blow must be greater than it would have been had the surface been of the same temperature as the gas.

And in the same way whenever heat is communicated from a gas to a surface, the force on the surface will be less than it otherwise would be, for the particles will rebound with a less velocity than that at which they approach.

Mathematically the result may be expressed as follows:—The symbols having the same meaning as before, ε representing the energy communicated in the form of heat, and δv the alteration which the velocity of the molecule undergoes on impact. As before—

$$p = \frac{d}{3g}v^2 \text{ or } u = \sqrt{\frac{3gp}{d}} \; ;$$

and—

$$\varepsilon = \frac{d \times v}{b}\left(\frac{(v+\delta v)^2 v^2}{2g} \right) = \frac{d \times v}{b}\frac{vv}{g} \quad \text{nearly,}$$

$$f = 2\frac{d \times v}{g} \times \delta v \; ;$$

$$\therefore f = \frac{2\varepsilon}{v} = 2\iota\sqrt{\frac{d}{3pg}} \; .$$

Therefore, in the case of steam at a temperature of 60—

$$f = 7\varepsilon,$$

and in air—

$$f = 5\varepsilon,$$

results which appear to be very large.

It must, however, be remembered that ε depends on the rate at which cold particles will come up to the hot surface, which is very slow when it depends only on the diffusion of the particles of the gas *inter se*, and the diffusion of the heat amongst them.

It will be much increased by convection currents, but these will (as has been already explained) to a certain extent produce an opposite effect. It would also seem that this action cannot have had much to do with Mr. Crookes's experiments, as one can hardly conceive that much heat could be communicated to the gas or vapour in such a perfect vacuum as that he obtained, unless indeed the rate of diffusion varies inversely as some high power of the density of a gas. It will be interesting, however, to see what light experiments will throw on the question.

ON SOME CHEMICAL ASPECTS OF PHYSICAL GEOGRAPHY.

By ALEX. S. WILSON, B.Sc.

I.

THE various departments of natural science are so closely related that no one of them can be studied altogether apart from the others; to become proficient, therefore, in any special science the student has not only to learn the principles of that science, but he has also to familiarise himself with those facts of other sciences which bear directly on his own studies. A result of this is that every advance, made in any science, is attended by a corresponding progression in the others. When a new fact is disclosed by scientific research we have not merely an addition to recorded observations, in a particular line of inquiry, but we are furnished with a means of investigating phenomena which form the subjects of other sciences.

Keeping this in mind, let us see what information may be gathered by reviewing, in the light of recent chemical research, some of the better-known operations of Nature. It is not our intention to enter on the wide field of chemical geology, nor is it desirable that we should, seeing that this subject has already received a considerable amount of attention. For the present we must be content to examine, by the aid of increased chemical knowledge, some of those processes which belong to that section of dynamical geology which treats of surface agencies, and, as being of most interest, we shall consider only those that are in any way concerned in determining the distribution of organised structures.

First, then, as to the chemical facts:—

It is well known that alumina and ferric oxide exercise a remarkable influence on certain salts in solution, but the explanation of the phenomenon is somewhat complicated. In the case of many salts it appears, from the experiments of Warington, that a decomposition takes place: thus, in the absorption of calcic phosphate by oxide of iron or alumina, from a carbonic acid solution, the phosphoric acid simply leaves the calcium and attaches itself to the iron or aluminium, forming ferric or aluminic phosphate. The behaviour of these oxides towards carbonates, sulphates, nitrates, and chlorides, is different; from solutions of these salts the oxides of iron and aluminium abstract the bases, whilst they reject in some measure the acids. In all these instances the absorption may be due to chemical affinity, but there are many examples of absorption which have not yet been resolved into chemical reactions, and which at present do not seem capable of being so resolved; there are circumstances, too, connected with this subject of absorption which still require an explanation. Moreover, some substances are absorbed in a manner quite at variance with our notions of what constitutes a chemical combination; the attraction for these would therefore appear to partake more of the nature of adhesion than of chemical force, and in this case what occurs may be analogous to that which happens when ether is mixed with a solution of potassic iodide from which the iodine has been liberated. The ether dissolves the iodine, forming a coloured solution, which separates, leaving the water clear; so, in the former case, we may regard the ferric oxide and alumina as dissolving a portion of the salt and then separating from the mixture, just as the ether does in the above illustration.

From this property arises the difficulty that is often experienced in washing precipitated oxides of iron, aluminium, and chromium, free from alkaline salts. Warington found that ferric hydrate, precipitated by potassic carbonate, only lost two-thirds of its potassium by a washing which should have reduced a perfectly soluble salt to $\frac{1}{144}$th of the original quantity. Similarly, he found that for ferric hydrate, precipitated by ammonia, every 100 grs. of anhydrous oxide retained 0·042 grs. NH_3, after being washed to an extent sufficient to have reduced

it to $\frac{1}{500000}$th of the salt originally present. The same observer has published (*J. Chem. Soc.*, 1868) experiments showing the amounts of various salts absorbed by ferric oxide and alumina from solutions of a definite strength, but as the results are only true for this particular strength of solution more observations are required. From some experiments of my own I am led to believe that the proportion of salt absorbed depends greatly on the strength of the solution, and that it diminishes rapidly as the solution is diluted.

This absorptive power is not only exercised towards salt in solution, but gaseous substances are influenced by it as well. Advantage is taken of this in the well-known process for purifying coal-gas from ammonia and objectionable sulphur compounds, by means of ferric oxide. Nor is this all. Boussingault found that a kilogramme of each of the following substances, after being ignited, when exposed to the air for two or three days, absorbed the following quantities of ammonia :—Sand, 0·5 m.grm.; powdered brick, 0·5 m.grm.; powdered bone-ash, 0·84 m.grm. These quantities are so small, however (0·00005 per cent), that it is difficult to say whether they were absorbed from the air, or were formed in the pores of the substance, by the direct union of nitrogen and hydrogen, or even that they are not due to imperfections in the apparatus and method employed to estimate the ammonia.

Other compounds of iron and aluminium exercise, to some extent, this influence on salts in solution, and notably their various combinations with silicic acid, which enter so largely into the composition of soils and clays.

Most soils and clays being mixtures, a part of their absorptive power may be due to uncombined oxide of iron or alumina, but this is small compared with the total absorption. Many clays contain, in addition to certain alkaline silicates, soluble salts of the alkalies. These salts may have been produced by the decomposition of the alkaline silicates, existing in the rock from the disintegration of which the clay was formed; or the argillaceous particles may have abstracted them from the water, by the action of which they were reduced to their state of minute division. Salts of the fixed alkalies might get into clay by either of these ways, but the ammoniacal salts which are found existing in clays must either have had an organic origin or have been absorbed from water. The organic matter in clays is generally so finely divided, and since water has been the pulverising agent, every trace of ammoniacal salt would have been removed by the washing process to which every part had been subjected, had it not been for the retentive power of the clayey particles. On account of this property the addition of clay has been recommended as a means of removing small quantities of ammonia from waters intended for domestic use. Lake water may in some cases owe its purity to the subsiding sediment removing salts in this way; at any rate it is nearly certain that the waters of many rivers and wells have been purified in this manner. Lawes, Gilbert, and Way, found that rain-water contained nitrogen equivalent to 0·0837 grain per gallon of ammonia. Now this is a much greater quantity than exists in uncontaminated river-water. Frankland and Armstrong obtained, as an average of fifty samples of water collected from running streams, 0·008 in 100,000 parts, or 0·0056 gr. per gallon. How, then, has this water, falling as rain, been purified? Chemists have ascribed this reduction in the amount of ammonia which has taken place in the waters of rivers, lakes, and wells, to the action of plants, but it may be questioned if this cause is sufficient to account for its removal to such an extent. I am inclined to the opinion that the soil is largely concerned in its removal, —first, because such waters as we have been speaking of could only have remained in contact with the absorbing surfaces of plants for a short time; and if we take into account the vast body of water constantly making its way into river-beds, this time is too short to admit of the ammonia being withdrawn from every small portion of water

flowing past; and secondly, because water coming in contact with much vegetable matter would be as likely to dissolve decaying nitrogenous substances as to have ammoniacal salts removed. If, then, whilst percolating through the soil, water be robbed of the substances it dissolved from the atmosphere, when falling as rain, may we not infer that the earthy *detritus*—borne down by rivers, and deposited on their banks and deltas—acts in the same way on the ammoniacal and other salts derived from the sewage and impurities with which rivers become charged as they proceed?

Experiment has shown that earthy matter absorbs a much larger proportion of salts from a strong solution than the same quantity of earthy matter does from a dilute solution. If, therefore, we were warranted in attributing the removal of ammonia from rain-water to the action of the soil, we cannot but conclude that the earthy matter, settling at the mouths of rivers, must carry down with it salts of potash, ammonia, and phosphoric acid, since a river is richer—as regards these substances—in its lower than in its upper course.

The mud of such a river as the Nile is rich in nitrogenous compounds, but the silt of our own rivers also contains ammonia, and that even when it appears to consist largely of coarse sand, and when one might have expected that all soluble salts would have been washed out. The investigations of Boussingault, and of Lawes, Gilbert, and Pugh, show, almost conclusively, that plants do not assimilate gaseous nitrogen, but that they derive nearly the whole of it from the soil as ammonia or nitric acid.

Schönbein suggested that ammonia might be formed by the evaporation taking place from the leaves, but there is no evidence that plants derive nitrogen from this source. Vegetation is therefore indebted for its nitrogenous—as for its mineral—constituents to the soil, and wherever these occur in considerable quantity one great condition of fertility is fulfilled. The presence, then, of substances so indispensable to the growth of plants, as salts of potash, ammonia, and phosphoric acid, must be an important factor in that rich and varied vegetable life for which river deltas and other alluvial districts are celebrated.

Agriculturists may consider phosphoric acid, in combination with iron or aluminium, too slow in its action to constitute a fertiliser; nevertheless, in the course of time, these inert phosphates do unquestionably exercise a favourable influence on the produce of any land, as the rich pasture-lands of Holland—the gift of the Rhine—or the abundant harvests of the Mississippi plains bear witness. Since, then, the luxuriant herbage of alluvial soils owes much of its necessary inorganic food to the absorbing action of earthy matter, this principle must, in past time, have had an important share in determining the distribution of vegetable structures. Here, then, we have another of the many interesting relations subsisting between the organic and the inorganic kingdoms of Nature.

From the vast formations of sedimentary strata which constitute so large a portion of the earth's crust, from mountains, from valleys, and from river-channels, we learn what changes the process of atmospheric denudation has effected, during past ages, on the configuration of the earth's surface. If we recollect, then, that each particle of every sedimentary rock must have been exposed, perhaps many times, to the action of water, the wonder is that these rocks should have retained any soluble substances whatever. Had these rocks, as they were formed, been just so much subsiding insoluble matter, when they came to constitute land, manifestly they could not have afforded a soil suitable for plants, since the necessary substances had previously been removed from them. The ultimate tendency of denudation would therefore have been to reduce the productiveness of all land to a minimum, had it not been for this conservation of soluble salts by the earthy ingredients of the soil. Without this arrestment these valuable salts must inevitably have been washed into the sea, there to accumulate uselessly, whilst

land vegetation, and consequently land animals, gradually disappeared. Perhaps our being able to detect many rare elements in sea water may be owing to the fact that their compounds were nearly all dissolved previous to the separation of the liquid from the solid constituents of our globe.

It may be well to recapitulate, in a few words, the cycle of operations we have endeavoured to trace :—We saw that the ammonia and nitric acid of the atmosphere (formed there by the direct union of their constituents, or derived from decaying organic matter) are washed by the rain into the soil. The soil is thereby enriched, whilst the water passes on purified. By-and-bye, however, the waters of the river become charged with sewage and other impurities, when the earthy sediment acts in the same way as the soil did on the rain water, withdrawing phosphoric acid, potash, ammonia, and nitric acid, before suffering the water thus impoverished to mingle with the ocean.

In this beautiful provision we have one of those marvellous adaptations which abound throughout the created universe, the disclosure of which everywhere repays the labours of the student of Nature.

I cannot better conclude these remarks for the present than by quoting the lines of the poet Marlowe, which seem peculiarly appropriate to this part of my subject :—

> " I walkt along a streame for purenesse rare,
> Brighter than sunshine, for it did acquaint
> The dullest sight with all the glorious pray
> That in the pebble-pavèd chanell lay.
> No molten crystall, but a richer mine
> Of Nature's rarest alchemie ran there."

ANALYSIS OF COBALT AND NICKEL ORES, OF NICKEL GLANCE,
AND A CONVENIENT AND EXACT METHOD FOR THE
SEPARATION OF ZINC FROM THE ABOVE-NAMED METALS.*

By Professor REMIGIUS FRESENIUS.

OWING to the great differences occurring in the analyses of similar samples of the above-mentioned ores, Prof. Fresenius introduced a new method for their treatment, which has given very satisfactory results. I will endeavour to explain his process as concisely as possible.

Method I.—Applicable to nickel glance in particular.

An accurately weighed sample is fused with eight times its amount of a mixture of equal parts of sulphur and carbonate of soda, the fused mass is treated with hot water, and the finely crystalline residue of sulphur metals is filtered off and well washed, by which operation arsenic and antimony pass into solution.

After igniting the filter the residue is treated with fuming nitric acid, and evaporated to dryness. The small amount of sulphate of lead remaining undissolved is not filtered off, but sulphuretted hydrogen gas is passed through the acid liquid till the latter is completely saturated with it. The filtrate from the sulphides of copper and lead is evaporated to dryness, the FeO is oxidised with chlorate of potash, a little HCl added, and the solution is then largely diluted, and carbonate of soda added till the reaction is nearly neutral, then acetic acid is poured in, drop by drop, till a clear brown solution of acetate of iron and nickel is formed. This done the solution is heated to boiling, and when in that state the basic salt of iron must at once be filtered off and washed. After this precipitate is re-dissolved, and again precipitated in the basic state as before. Test a little of the precipitate whether it is free from nickel, if not, the above operation must be repeated till all the nickel is removed. The filtrates from the iron precipitate must be brought together and evaporated to a moderately small bulk. The solution is heated to boiling, and caustic potash is then added in slight excess. The hydrated oxide of nickel is washed and

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* Communicated by Mr. Harry G. Shaw

ignited, and then reduced in a stream of hydrogen gas. The resulting metal is now brought on a small filter and treated with boiling water to remove any traces of caustic potash ; after ignition of the filter it is again heated in a stream of hydrogen and weighed. The small amount of silica it contains is separated by dissolving the metal, and evaporating the SiO_2 to dryness, and estimating the amount, which is to be subtracted from the total quantity.

Method II.—Especially applicable to cobalt-nickel ores, and for the separation of zinc from those metals.

Instead of the fusion process, as described in Method I., the finely powdered ore is digested for some time with aqua regia and filtered. The residue must be perfectly white, and if not so, must be fused with bisulphate of potassium, the fused mass is dissolved in HCl and water, the solution filtered off, and the filtrate added to the principal one. The analysis is then continued exactly as in Method I.

Should the ore contain zinc the sample is treated as follows :—

The sulphides of nickel and cobalt are dissolved up, the solution evaporated to a small bulk, and then chloride of ammonium added in the proportion of 5 grms. NH_4Cl to 0·2 grm. ZnO ; the mass is then evaporated to dryness on the water-bath till all the NH_4Cl is removed, and with it all the zinc. The remaining residue is treated with HCl, a little NO_3 being also added ; the solution is then evaporated to a very small bulk to remove the excess of acid, and then precipitated with caustic potash, and the analysis continued as in Method I.

When nickel and cobalt are to be examined *separately*, evaporate the ammoniacal filtrate to dryness, remove the ammonia salts by gentle heating, dissolve the residue in HCl, with addition of a little NO_5 ; and when much nickel and little cobalt is present estimate the latter as nitrite of sesquioxide of cobalt and potassa ; but if, on the contrary, there is much cobalt and little nickel, the solution of the chlorides of these metals are treated with KCy in excess, and after addition of pure caustic potash the nickel is precipitated warm as black hydrated oxide of nickel.

In the first case the nitrite of the sesquioxide of cobalt and potassa, in the latter the oxide of nickel, is dissolved in HCl and precipitated with caustic potash, and eventually estimated as metal.

Glasgow, June 27, 1874.

COMPARATIVE METHOD OF DETERMINING TANNING MATERIALS.

By E. SCHMIDT.

THE question to be solved is—Knowing that a certain weight, P, of pure tannin is required to obtain a certain result, how much of another tanning body, *e.g.*, the extract of a wood, is required to produce the same result None of the published methods for the determination of tannin is sufficiently precise, easy, and rapid for industrial purposes. The author proposes a modification of Pribram' method with sugar of lead.

A. *Preparation of the Test-Liquor.*—50 grms. neutral acetate of lead are dissolved in 400 grms. of alcohol at 92 per cent, and distilled water is added so as to make up 1 litre.

On the other hand, 1 grm. of tannin is dissolved i 40 grms. of alcohol at the same strength, and the solution is made up with water to the bulk of 100 c.c.

This being done, 10 c.c. of the tannin solution ar taken, 20 c.c. of water are added, and heated to 60°. Th lead liquor is then run into the hot solution with a burett e graduated to tenths of a c.c., so long as a precipitate i s formed. At this temperature, and with these alcoholised liquids, the precipitate forms and settles rapidly. Iodide of potassium may be used as an indicator to show excess of lead, proceeding in the same manner as is done with

ferrocyanide in titrating phosphates with nitrate of uranium. If we suppose that to precipitate 10 c.c. of the tannin solution 28 degrees of the lead liquor have been required, then 2·8 c.c. of the latter = 0·10 grm. of tannin.

B. *Preparation of the Sample to be Tested.*—Suppose that chesnut-bark is to be examined. It is coarsely powdered, and 10 grms. are mixed with an equal volume of washed sand, and exhausted with water at 50° or 60° C. The filtered liquid is evaporated to dryness in the water-bath in a tared porcelain capsule. After evaporation the capsule is weighed, which shows the yield of the bark in aqueous extract. This extract is taken up in 40 grms. of alcohol at 92°, and water is added to make up 100 c.c. This liquid is filtered if needful. In this manner the resinous, albumenoid, pectic, and gummy matters are got rid off.

C. *Titration.*—The liquid thus prepared is divided into two parts. The first, one-third of the entire volume, serves for direct determination of the acetate of lead. Suppose that a gramme of the dry extract of chestnut has required—for 10 c.c. of the tannin liquor—in three successive experiments, 16, 17, and 16 degrees of the burette, which corresponds to 57 per cent of tannin. But this figure 57 represents, not only tannin, but every other substance capable of precipitating acetate of lead.

The tannin is then absorbed with bone-black, previously washed with hydrochloric acid, and dried at 100° C. in the following manner:—We act with bone-black upon the tanning liquor, and on a solution of pure tannin prepared at a standard somewhat lower than that indicated for the extract by the first direct titration. In the present case this solution of tannin should be prepared at 55 per cent.

From one and the same glass tube, about 1 centimetre in diameter, we cut off two lengths of 20 centimetres each, and we draw out each at one of its ends. The two tubes are fixed perpendicularly, with the point downwards, and plugged with a little carded cotton. Into each is put 10 grms. of the bone-black, pouring into one of them the second part of the tanning liquor under examination, and into the other the same volume of the pure solution of pure tannin at 55 per cent.

We then take of the tanning liquor (which has retained its original brown colour in spite of the bone-black) 20 c.c., and after having heated it to 60° C., we drop in the standard lead liquor from the burette as before. Two successive trials show 16 degrees, = 8 degrees for 10 c.c., in place of the 16 degrees found for 10 c.c. on direct titration. On the other hand, 20 c.c. of the solution of pure tannin require 14 degrees, or 7 for 10 c.c. Thus we see that in the tanning liquor (chestnut extract) there is a certain quantity of matter which acts upon the standard lead solution like tannin, corresponding to 1 degree of the lead liquor, *i.e.*, to 357-thousandths of a centigramme of tannin, 28 degrees therefore correspond to 10 centigrammes. The figure 57 obtained by direct titration is, therefore, too high by 3·57 per cent, and the extract contains 57 − 3·57 = 53·43 per cent of tannin.—*Bull. de la Soc. Chim. de Paris.*

CENTENNIAL OF CHEMISTRY, 1774-1874.

THE following communication is being circulated by Dr. H. Carrington Bolton, through the *American Chemist* and other papers :—

The year 1774 was rendered memorable by great chemical activity. It is not possible to assign to chemistry any definite birth-year, but so many remarkable discoveries were made in 1774 that we may, with good reason, date the foundation of modern chemical science from that period.

It would be quite foreign to the object we have in view to give here any detailed account of the state of the science at the period referred to. We may mention, however, a few of the most important discoveries which made the year 1774 noted in the annals of chemistry.

The eminent Swedish chemist, Scheele, first isolated chlorine, calling it, in accordance with the accepted theories of the day, " dephlogisticated muriatic acid." He also recognised baryta as a peculiar earth, and it henceforth took a place among the elementary substances. Scheele also published in this same year his masterly essay on manganese.

Lavoisier was engaged in an investigation of the cause of the increase in weight of tin when calcined in close vessels—a research which led him to subsequent discoveries of immense importance.

Wiegleb proved alkalies to be true natural constituents of plants. Cadet described an improved method of preparing sulphuric ether. Bergman showed the presence of carbonic acid in lead white. On the 27th of September in this year Comus reduced the " calces " of the six metals by means of the electric spark before an astonished and delighted audience of *savants*. On the 1st of August, 1774, Priestly discovered oxygen, the immediate results of which were the overthrow of the time-honoured phlogistic theory and the foundation of chemistry on its present basis.

It surely requires no lengthy argument to prove that the year 1774 may well be considered as the starting-point of modern chemistry.

Now I propose that some public recognition of this fact should be made this coming summer. Would it not be an agreeable event if American chemists should meet on the 1st of August, 1874, at some pleasant watering-place, to discuss chemical questions, especially the wonderfully rapid progress of chemical science in the past hundred years.

Centennial celebrations are now in order. The Bostonians have renewed the memories of the Boston Tea-Party. Already the country resounds with preparations for a National Centennial in 1876. Why should not chemists meet to enjoy a social reunion in commemoration o events important alike to science and civilisation ? Should this proposed meeting receive your approbation, have the kindness to offer suggestions as to the proper method of bringing it before the scientific portion of the communiy . Details as to place, &c., will naturally be deferred for t present.

NOTICES OF BOOKS.

Qualitative Chemical Analysis and Laboratory Practic
By T. E. THORPE and M. M. PATTISON MUIR.   London
Longmans, Green, and Co.

THIS work forms one of the " Text-books of Science " at present in course of publication by Messrs. Longmans, and is stated to be edited by C. W. Merrifield, F.R.S. What share this gentleman—who, if a chemist at all, is not known as such—has taken in the work, does not appear. This book is divided into two distinct parts. We have first a course of experimental chemistry extending to the non-metallic elements and their compounds.

The second part is a systematic treatise on qualitative analysis. The first section is devoted to the description of certain preliminary operations, such as the use of flame-reactions, and the employment of the spectroscope. In the second section, the reactions, both wet and dry, of the ordinary bases and acids are described, and a synopsis of analytical methods is superadded. In the third section are given tests for the rarer elements,—which we are glad to find are not omitted—and indications are furnished as to their probable occurrence. The fourth and fifth sections treat of the detection of poisons, and the examination of urine and urinary calculi. The appendix contains a list of apparatus, and chemicals required for performing the operations described in the body of the work, hints for the preparation of pure reagents, and some useful tables. Upon the whole the instructions given may be fairly pronounced accurate, and judiciously selected. In speaking

of the molybdic test for phosphoric acid, it might have been well to point out the means of discriminating between the phosphoric compound and the analogous deposits formed by the silicic and arsenic acids. The book will prove serviceable as a guide to students desirous of acquiring a knowledge of analytical chemistry.

A Treatise on Food and Dietetics Physiologically and Therapeutically Considered. By F. W. PAVY, M.D., F.R.S. London: J. and A. Churchill.

No modern systematic treatise on this subject has hitherto existed in the English language, and Dr. Pavy has therefore undertaken a most important and useful task. The work begins with general introductory remarks on the dynamic relations of food, and on its origination. Alimentary principles are arranged under the four groups of nitrogenous principles, hydrocarbons or fats, carbohydrates and inorganic materials; the colloquial distinction of "food and drink," and Liebig's classification into plastic and respiratory elements being shown to be unsatisfactory. The preponderant importance of nitrogenous matter for the development and renovation of the tissues is fully recognised. But the doctrine that muscular work is dependent on, and proportioned to, the destruction of muscular tissue by oxidation is abandoned. On this point the well-known experiments of Drs. Fick and Wislicenus seem convincing. The elimination of urea appears, indeed, to stand in a much closer relation to the food taken than to the work performed. In a cat the amount of urea excreted daily per kilogramme of body weight, was seen to rise from 2·958 grms. to 7·663, with an increase of the amount of meat eaten from 44·188 to 108·755 grms. The fats especially, and the non-nitrogenous organic portion of food generally, are regarded as heat, or more correctly as force-generators, the respective amounts of heat produced by 1 gramme of grape-sugar, starch, and fat being 3277, 3912, and 9069. But the nitrogenous constituents of food in addition to their tissue-forming function, share also in the evolution of heat, 1 grm. of albumen yielding 4263 units of heat. The dispute as to the dietetic value of alcohol is fully stated. Liebig considered that it was consumed by oxidation like other non-nitrogenous alimentary principles, and that it stood second to the fats only as a respiratory material. This view met with very general acceptance until the experiments of MM. Lallemand, Perin, and Duroy were made known. These physiologists found that alcohol passes off from the body in an unchanged state after its ingestion. The breath, perspiration, and urine, both of men and of lower animals dosed with alcohol, was tested, and its presence was very plainly shown. In the brain of an animal killed 36 hours after the consumption of alcohol, it was also recognised. The test used was extremely delicate; one part of bichromate of potash was dissolved in three hundred parts of pure concentrated sulphuric acid, forming a bright red liquid, which, in contact with alcohol, by a well-known reaction changes to an emerald green. But the test is unfortunately too delicate. Dr. Dupre found that six weeks after total abstinence from alcohol, and even in the case of a teetotaller, a substance was eliminated in the urine which gave all the reactions ordinarily used for the detection of traces of alcohol. On the other hand, none of the experiments on the faith of which the transformation of alcohol within the system was denied, have been at all quantitative. That a liquid so volatile as alcohol should be recognised in the excretions, is certainly no proof that it entirely escapes transformation.

The author next passes to the more popular branch of his subject. Taking in review the various articles of food, he gives an account of their chemical composition and their dietetic value. The occasional unwholesomeness of meat in consequence of trichinæ, of malignant disease, or of decomposition is fully described. It is to be regretted that in speaking of blood its very objectionable character as an article of food has not been mentioned.

In the important section on Practical Dietetics, the vegetarian question is very fairly examined. It strikes us that the dietetic reformers find themselves in a dilemma. If they allow the use of milk and eggs, as most of them do, they greatly improve their cookery at the expense of their logical consistency. If they reject milk they accuse nature, or rather God, of an error in having appointed it for the nurture of the young of the highest animal group. It must also be remembered that certain rodents, such as the common rat, depart more widely than we do from the carnivorous type in their dentition, and yet are omnivorous. At the same time, we must admit, with Dr. Pavy, that "the consumption of meat to the extent that many persons believe necessary for the maintenance of health and strength is not really so."

This work is not only indispensable to the medical practitioner, but it is one with which every educated man ought to make himself familiar.

Annual Record of Science and Industry for 1873. Edited by SPENCER F. BAIRD. New York: Harper Brothers.

A VALUABLE collection of facts, taken from the leading scientific and technological journals of America, England, and the Continent. Though the abstracts given are necessarily brief, the work forms a kind of general index or key to the researches, discoveries, and improvements made during the year, and refers those who require more detailed information to the original documents. The space devoted to "Chemistry and Metallurgy" does not exceed eleven pages, but the section "Technology" is mainly devoted to the chemical arts. It is curious to find a bad process for making gun-cotton, derived originally from an American source, quoted from a French journal, and placed under the head "Mechanics and Engineering." As a manual for reference we consider this work a decided improvement on the Year-Book of Facts.

CORRESPONDENCE.

THE CHEMICAL SOCIETY.

To the Editor of the Chemical News.

SIR,—I am quite of the opinion of your correspondent "Equivalent" with regard to the *Journal of the Chemical Society.* In its present condition it is an expensive and blundering attempt to monopolise the literature of chemistry in this country. The appointment of "abstractors" was an error. Surely Mr. Watts, who has shown himself so enthusiastic a compiler, could have done the compilations and abstractions necessary for the Journal at less than half the cost. But I do not agree with your correspondent when he suggests a return to the old *quarterly* issue; this, I take it, is simply satirical. Let the Journal be issued monthly as before, and devoted simply to the papers read at the Society, and the discussions thereon. Fancy the *Comptes Rendus* of the Paris Academy giving "abstracts of foreign papers!" Let the *Journal of the Chemical Society* be the organ of the Society, and not endeavour to compete with journals of chemistry properly so-called.

The above remarks do not apply to the excellent journal of the *Societe Chimique* of Paris, for that was a journal before the Society was formed.—I am, &c.,

F. C. S.

ABSORPTION OF NITROGEN BY SOIL.

To the Editor of the Chemical News.

SIR,—The results obtained by M. P. P. Deherain, of which you have recently given us a *resume,* are clearly of great importance, but until the reaction he has studied is further elucidated it will be difficult to draw any practical conclusions from his experiments. Thus he assumes that more or less of the nitrogen that disappears from the ex-

perimental atmosphere is converted into ammonia, but I have been unable to find in his original papers that he actually ascertained the presence of ammonia in any instance; while the nitrogen found in some of his experiments after evaporating to dryness a caustic soda solution could not possibly have existed as ammonia.

Again, he finds that most nitrogen is absorbed from the atmosphere when no oxygen is present, and concludes that the vegetable matter in the deeper layers of the soil will in the same way absorb nitrogen, and thus enrich the soil. T. Schlœsing has, however, shown that a vegetable soil containing nitrates undergoes a striking change if deprived of oxygen, free nitrogen being *evolved* in greater quantity than that of the nitrates present, so that nitrogenous organic matter is plainly decomposed.

It seems therefore premature to conclude, in the absence of further evidence, that soils are actually enriched with nitrogen in the way that Deherain supposes. He considers, however, that soil must obtain nitrogen from the atmosphere, because the nitrogen in crops is generally greater than the nitrogen in the manure. He should show, however, that the nitrogen in crops is greater than the nitrogen in manure, *plus* that received in rain, and that absorbed as ammonia (by crops and soil) from the atmosphere, before the argument can be of any weight; and agricultural chemistry is hardly yet in a position to supply the requisite data.—I am, &c.,

R. WARINGTON.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, May 18, 1874.

Note accompanying the Presentation of Vol. VI. of the "Œuvres de Lagrange."—M. Serret.—This completes the series.

On Magnetic Bundles made up of Separated Plates.—M. Jamin.—Combining 22 magnetised plates (each 1 m.m. long, 1 m.m. thick, and 50 m.m. broad) in a bundle, with pasteboard 0·6 m.m. thick between adjacent plates, each plate lost magnetism, and so the bundle, the loss of the latter being 50 per cent, which is less than in the case (first experimented on) of superposition without intervals; the loss was then 66 per cent. In this first mode all the magnetism retained was carried to the exterior; there was none, or almost none, between the plates. In the other mode the quantity remaining (151·1) was divided into two portions:—(1), 85·5, which was expanded on the exterior; and (2), 65·6, which remained in the intervals. With wider intervals the exterior magnetism is diminished, the interior increased; and gradually the plates act as if they were independent.

Letter of M. Faye, enclosing Reply by M. Gautier.—M. Gautier argues for the idea of solar "scoriæ," commending the study of molten alloy (brass *e.g.*), the phenomena of which are strikingly analogous to what appears in the solar furnace. He confirms Mr. Langley's observation ("Monthly Notices") of an appearance of crystallisation in some spots, suggesting rather mineral or saline deposits, or certain gemmation, than the action of cyclones. M. Faye thinks the identity of spots with cyclonic phenomena would long since have been recognised had not singular notions been prevalent about the latter. Against these M. Faye directs all his efforts (he says). The persistence of the solar spots is no difficulty, as even our cyclones may last for whole weeks.

New Apparatus for the Transfusion of Blood, proposed by M. Mathieu.—M. Bouley.—This apparatus (of which a drawing is given) consists of a glass receiver, communicating above with a funnel, below with the vein. The tube between funnel and receiver passes through an ampulla of caoutchouc, which forms a reservoir of air, communicating with the air in the receiver. Blood poured into the funnel passes to the receiver, and the ampulla, being then pressed, is forced into the vein. On relaxing the pressure, air returns to the reservoir from the receiver, into which more blood then flows from the funnel.

General Ideas on the Mechanical Interpretation of the Physical and Chemical Properties of Bodies (*continued*).—M. Ledieu.—This important paper is hardly suitable for abstraction. The author regards the ether as of the same nature as *ponderable* substances; its differences from these, more apparent than real, depend both on the functions of the distances measuring the molecular action of its atoms on one another and on the heavy atoms, and on the relative smallness of its atomic mass. To the former is due the extreme *elasticity* attributed to the ether; to the latter the *imponderability*, which is essentially relative, "and will, in all probability, be one day proved experimentally, by some physicist of genius."

Note on some Thermometric Observations during Winter, in the Alps.—Dr. Frankland.

Influence of Ferments in Surgical Maladies.—M. Alph. Guerin.—The author maintains that fermentation is not produced in pus which is in contact only with filtered air. His observations were upon wounds kept covered with wadding. Good ventilation in hospitals may not alone do much to remedy the conditions of putrid fermentation.

Employment of Fragments of Iron instead of Lead Shot in the Rinsing of Bottles.—M. Fordos.—Lead shot, where so used, often leaves carbonate of lead on the internal surface, and this is apt to be dissolved in the wine or other liquids afterwards introduced, with poisonous results; and particles of the shot are sometimes inadvertently left in the bottle. M. Fordos states that clippings of iron wire are a better means of rinsing. They are easily had, and the cleaning is rapid and complete. The iron is attacked by the oxygen of the air, but the ferruginous compound does not attach to the sides of the bottle, and is easily removed in washing. Besides, a little oxidised iron is not injurious to health. M. Fordos further found that the slight traces of iron left had no apparent effect on the colour of red wines; it had on white wines, but very little; and he thinks it might be better to use clippings of tin for the latter.

Transmission of Irritation from one point to another in the Leaves of Drosera, and on the Rôle played by the Tracheæ in these Plants.—M. Ziegler. —It is by the tracheæ or surrounding fibres that the irritation is transmitted from hair to hair, and they must be able to communicate with each other laterally by their points of contact.

Shock of Bodies.—M. Darboux.

Temperature of the Sun.—M. Violle.—The author here deals with the *static* method, in which a thermometer is exposed to solar radiation till the temperature indicated by it is stationary, and this temperature is then compared with that of the enclosure. Suppose a smoke-blackened sphere with blackened thermometer bulb, but infinitely small, at the centre. In equilibrium of temperature the enclosure sends to the thermometer a quantity of heat, Sa^t, a being the constant of Dulong, or 1·0077, and the thermometer sends back the same quantity. Now pierce a circular hole, ω, in the sphere, such that it is seen from the centre under the same angle as the apparent diameter of the sun, and direct it to the sun. The real action of the sun on the bulb will then be the same as that of a small disc of surface, ω, placed at the hole, and having the same diameter and emissive power as the sun. We may, then, define the temperature of the sun by the temperature we must attribute to this imaginary disc, having the emissive power of soot, to produce on the thermometer

the same effect as the sun actually produces. Let x be this temperature, θ the stationary temperature of the thermometer receiving solar radiation through ω: the quantity of heat emitted by the thermometer, which was Sa^t at temperature t, is become $Sa\theta$; and putting this quantity equal to the sum of the quantities emitted by the enclosure and by the sun, we have $Sa\theta = Sa^t + \omega a x$. This is exactly M. Vicaire's formula; but a term of correction has to be introduced, for the thermometer has finite dimensions, and the hole has to be enlarged so that the solar rays may meet the whole of one hemisphere of the bulb. Consider, then, an aperture, Ω, large enough for this. Each point of the bulb, if the latter be small enough relatively to the enclosure, will be nearly in the same condition. Take any point then: it is subject (1) to the radiation of all the protected portion of the enclosure; (2) to the radiation of the sun equivalent to that of a surface ω placed at a distance equal to the radius of the sphere, and maintained at the same temperature as the sun; (3) to the radiation of a portion of the sky near the sun, which acts as a surface, $\Omega - \omega$, of an unknown temperature, y. The exact equation is, then, $Sa\theta = Sa^t + \omega a x + \Omega a y$. The author gives an example of his actual observations, in which the total intensities of the three radiations to the thermometer, by the surfaces S, ω, and Ω, were nearly proportional to the numbers 15, 1, and 0·1.

Studies on Electric Chronographs and Researches on the Induction Spark and Electro-Magnets.—M. Deprez.—The author sought (by a method described) to determine the retardation of the induction spark, i.e., the time elapsing between rupture of the inducing current and explosion of the spark. Of all methods of registering this is the most rapid, the retardation being generally less than $\frac{1}{10000}$ of a second. But the spark presents disadvantages; its production is very capricious, and depends much on the manner of rupture; it is nearly always multiple, and it thus struck several points of the cylinder (in the arrangement adopted). When the cylinder moves very quickly its trace became very uncertain. A large induction coil is required. And the number of sparks one coil can produce in a second does not exceed two or three hundred. This was insufficient for the author's purpose (which was to find twenty points of a curve representing the pressure of gases of powder in a gun). For he had to produce two consecutive signals at an interval of $\frac{1}{10000}$ of a second. He had therefore to use twenty independent bobbins and twenty batteries. He tried the other processes of electric registration, the use of electro-chemical paper, and that of electro-magnets. The first was abandoned as inferior to the induction spark, the second he succeeded in improving till he could measure the duration of a phenomenon with an error less than $\frac{1}{30000}$ of a second, and that with a very simple and cheap apparatus. Details will be given later.

Movements of Air in Tubes.—M. Bontemps.—In the pneumatic tubes for transmission of telegrams, there being an engine at the end supplying air to drive the case along, the manometer at this end, after a short interval from the time of dispatch, becomes stationary. There is a permanent state succeeding a variable. 1. When the permanent state is established the velocity of the case is uniform. 2. The separation (*ecart*) of the two pistons, which have a common motion in the tubes, is maintained throughout the whole portion of the distance from which the *regime* is produced. The author then asks: Is not the movement of the air that of a fluid of constant density, in which, consequently, the pressure and the temperature vary proportionally? If so we may attempt an application to this new class of phenomena of the law of Ohm governing the the galvanic current. He does so.

Studies of the Properties of Explosive Substances. —M. Abel.—(Fourth Memoir). Refers to the velocity with which duration is transmitted in various circumstances.

Compounds of Arsenic Acid with Molybdic Acid. —H. Debray.—These two acids form compounds as complex and as well-defined as the phospho-molybdates. H. Rose pointed out that arsenic acid forms with molybdate of ammonia in a nitric solution a yellow precipitate like that given by phosphoric acid under the same circumstances. This substance, like its analogue, is the ammoniacal salt of a compound yellow acid, resulting from the combination of 1 equivalent of arsenic acid with 20 equivalents of molybdic acid. Its composition may be represented by $3NH_4O,AsO_5,2OMoO_3$.

Soluble Starch.—M. Musculus.—Chemists are not agreed as to what should be understood by soluble starch. Some apply this name to a matter which takes a blue colour with iodine, which may be washed out of starch by means of water, and which Vaegeli has called granulose. In the opinion of others the true soluble starch is the substance which Béchamp obtained on acting upon starch with sulphuric acid, and which takes a violet colour with iodine. Granulose, though it readily passes through filter-paper, is not truly soluble in water. By evaporation it may be separated in a state completely insoluble even in boiling water. Béchamp's soluble starch is a mixture of several bodies, including granulose, true soluble starch, and products of the decomposition of starch, such as dextrin, glucose, or glucosin. The author has described under the name of globulised dextrin a body, insoluble in cold water, obtained by dissolving starch in acidulated boiling water, and evaporating to a syrup after neutralising the acid and filtering. There is formed an abundant deposit of granules, insoluble in cold water, but soluble at 50°, so that they may be freed by washing from accompanying traces of dextrin and glucose. By means of alcohol they may be purified from granulose, and we thus obtain pure soluble starch. When dried in the air it is white and resembles starch. If recently washed it is insoluble in cold water, and does not reduce salts of copper. If left for some time in contact with water it dissolves sensibly, a little sugar being formed at the same time. Its rotatory power is almost quadruple that of dehydrated glucose. It dissolves perfectly in water at 50°, and is not re-precipitated as the solution cools. Diastase splits up soluble starch in the same manner as common starch, but much more readily and perfectly.

Decomposition of the Tungstate and the Molybdate of Soda by Sal-ammoniac.—F. Jean.—The tungstate and the molybdate of soda are decomposed in an identical manner when kept in ebullition with sal-ammoniac. The chlorine of this salt saturates the base of the metallic salt, the acid of which combines immediately with the liberated ammonia to form an alkaline salt, which, on boiling, becomes an acid salt and loses ammonia. It is remarkable to find a decidedly acid liquor which evolves ammonia.

Constitution of Clays.—Th. Schlœsing.—This valuable paper is reserved for insertion in full.

Identity of Bromoxaform and Pentabromated Acetone.—E. Grimaux.—The author finds that acetate of methyl and methyl-alcohol are not attacked by bromine in the cold; that at 150° to 170° the acetate of methyl is transformed into bromide of methyl and bromacetic acids; that the compound formed by the action of bromine upon the alkaline citrates is pentabromated aceton; that the chlorated bodies obtained by Plantamour in the action of chlorine upon citric acid and the citrates are chlorated derivatives of aceton and not derivatives of methyl-acetic ether.

Bulletin de la Societe Chimique de Paris, tome xxi., No. 6, March 20, 1874.

At the meeting of the Society, February 20, M. Willm communicated a memoir by M. Cleve on didymium, and a note by M. Nilson on the selenites. M. Grimaux presented a paper by M. Franchimont on the preparation of malonic acid. M. Friedel announced that when studying conjointly with M. Jules Guerin, the compounds obtained by the action of hydrogen on chloride of titanium, he

found that the gold-coloured lamellæ which Ebelmen took for a protochloride, are in reality an oxychloride. This latter is obtained in much greater abundance by passing a mixture of chloride of titanium, and of hydrogen over titanic acid. He pointed out a curious reaction of sulphate of alumina, which at common temperatures, and more rapidly with the aid of heat, transforms fluoride of calcium into sulphate of lime, fluoride of aluminium being produced at the same time. M. Pisani finds that turnerite, a rare mineral regarded as a phosphate of lime, is identical with monazite, the phosphate of cerium. M. Millot made known the first results of his investigations on the phosphates of iron and alumina. M. Henninger communicated the continuation of his researches on the reduction of the polyatomic alcohols by formic acid.

New Saccharimeter, to be used by Perfectly Monochromatic Light.—M. Leon Laurent.—This improved saccharimeter has been already noticed in the CHEMICAL NEWS. The details of its construction would be unintelligible without the aid of illustrations.

Researches on Didymium.—M. P. T. Cleve.—The author describes the sesquioxide, chloride, bromide, chloroplatinate, chloraurate, bromaurate, fluorine, platino-cyanide, ferrocyanide of didymium and potassium, sulphocyanide, nitrate, perchlorate, iodate, periodate, formiate, acetate, seleniates, potassio-sulphate, potassio-seleniate, ammonio-sulphate, ammonio-seleniate, sodio-sulphate, sodio-seleniate, sulphite, selenite, hyposulphate, carbonate, potassio-carbonate, ammonio-carbonate, sodio-carbonate, oxalate, potassio-oxalate, tartrate, and pyrophosphate.

Salts of Selenious Acid.—M. L. F. Nilson.—The author gives an analysis, and a brief description, of a number of selenites.

Preparation of Malonic Acid.—M. Franchimont.—The author modifies the procedure of Kolbe and Muller, substituting brom-acetic ether for chlor-acetic. Succinic acid is found among the products.

Comparative Method of Determining Tanning Materials.—E. Schmidt.

New Apparatus for Determining the Tannin Contained in the Different Astringent Matters Employed in Tanning.—A. Terreil.—This paper requires an illustration. The principle of the process is the absorption of oxygen by tannin in presence of alkaline liquids. The author admits that the determination requires twenty-four hours for its completion.

April 5, 1874.

At the meeting of the Society, March 6, M. Terreil gave an account of the properties and mode of preparation of certain alloys of manganese, founded upon the action of the metals upon anhydrous manganic chloride. This chloride is obtained in a fused state by heating the dried chloride in a current of hydrochloric acid gas. Aluminium decomposes the chloride, yielding an alloy, Mn_3Al, which scratches glass. Its fracture resembles that of amalgamated tin. The alloy of manganese and magnesium is softer. Zinc acts upon chloride of manganese with explosion.

M. Basarow communicated the first results of his researches on fluoxyboric acid. This supposed acid appears to be merely a solution of the fluoride of boron in water.

M. Jannetaz described a variety of hydrated silica, found at Bry-sur-Marne. It loses its water spontaneously, but does not cease to be soluble in alkalies. It resumes its moisture—33 per cent—if allowed to remain in water. It presents the general characters of the zeolites.

Action of Hypobromites upon the Nitrogenised Matters of Urine, with an Application to the Determination of Urea and Uric Acid.—M. E. Magnier de la Source.—Solutions of urea are completely decomposed in the cold by hypobromite of sodium. If an excess of soda is present nitrogen alone is given off. The presence of chloride of sodium does not hinder the decomposition.

Creatine is also completely decomposed under the same circumstances. Uric acid only loses half its nitrogen in the cold, but if heated the decomposition is complete. The directions for the determination of urea and uric acid should be accompanied by a diagram.

On a Natural Phosphate of Cerium containing Fluorine.—This mineral is found at Kararfvet, near Fahlun, in Sweden. Its colour is a light yellow shading into brown, its lustre feebly vitreous. It yields a greyish-yellow powder, and its specific gravity is 4·93. The crystals are very large. Hydrochloric acid attacks it slowly and imperfectly, with disengagement of chlorine. The mineral is completely attacked by fusion in fine powder with bisulphate of potash or carbonate or soda. If heated with concentrated sulphuric acid it dissolves without residue. It is infusible before the blowpipe. It has the property of double refraction. It is found scattered in felspar albite, and is almost always associated with gadolinite (silicate of yttria and cerium), hjelmite (a variety of yttrotantalite), emerald, &c. Its average composition is—

Oxide of cerium ⎫	
,, lanthanum ⎬ .. .. .. 67·40	
,, didymium ⎭	
Lime .. .. 1·24	
Magnesia .. .. traces	
Oxide of iron .. .. 0·32	
Phosphoric acid .. .. 27·38	
Fluorine.. .. .. 4·35	
Water .. .. traces	
	100·69

Action of Ammonia upon Aceton.—W. Œchsner De C. and A. Pabst.—In the action of ammonia upon aceton there are formed no traces of methylamine and aldehyd. The product of the reaction is the acetonin of Stædeler.

Correspondence from St. Petersburg. — Feb. 18 (March 2), 1874; M. W. Louguinine.—This paper contains an account of the recent progress of chemistry in Russia, and of the researches of M. Mendeleeff—physical rather than chemical—of the resistance of glass tubes to internal pressure, and on the exact measurement of temperatures. M. Boutteroff communicates a description of an apparatus for the production of hydrochloric acid; researches on the terebene and cymene obtained from the essence of terebenthine; on behalf of Wagner and Zaytzeff, a preliminary note on a new synthesis of the alcohols; on behalf of Wreden, on the hexa-hydro isoxylene which he has obtained from isoxylene as well as from camphoric acid. The latter the author considers a mixture of two isomers. Markovnikoff communicates results of experiments made by Demstchenko, on the action of the protochloride of phosphorus upon isobutyric aldehyd, which transforms the latter into a crystallisable polymer, which melts at 59° to 60° and distils at 194°; also a third isomer of pyrotartaric acid, obtained by Kolbe's method. On behalf of Elisafoff, a paper on the cetene of cetylic alcohol, which the author considers as a mixture. Papers have also appeared by Lazarenko, on cetene; by Dianine, on the action of chloride of benzol on dinaphthol; by Menschoutkine, on the parabanates of silver; by M. Schœne, on the reaction of water and ozone; by M. Lioubavine, on the action of ammonia upon valeric aldehyd. Kourbatoff has examined the oil extracted from the root of *Acorus Calamus*. Drobiasguine has experimented on the transformations of ethyl-crotonic acid. M. Effit Eghis has published a paper on the theory of etherification.

Relation between the Specific Gravity of Bessemer Steels and their Percentage of Carbon.—Koppmayer.—The author finds that each increase of carbon corresponds to a decrease of specific gravity.

Researches on Alloys.—M. A. Riche.—A series of results relating rather to the mechanical than the chemical properties of certain alloys.

April 20, 1874.

Chemical Purification of Wool.—MM. Duclaux, Lechartier, and Raulin.—This paper treats of the removal from wool of the so-called "burls," *i.e.*, fragments of straw, thistles, and other vegetable matter, which, getting entangled in the fleece of sheep, accompany the wool through all stages of its manufacture. As the burls do not take the same dyes as the wool, the goods must either be submitted to a separate process of burl-dyeing, or the spots must be touched with special solutions made for the purpose, "burling-inks," or, lastly, the burls must be plucked out by hand with pincers. Processes have therefore been patented, by Fenton and Crom in England (1853), and by Izart and Lecoup in France (1854), for destroying these "burls" with acids. The process consists in steeping the wool, either raw or woven, in sulphuric acid, at 3° or 4° Baumé, draining it in a centrifugal machine, and drying it in a stove at 100°. The authors have examined all the circumstances of this process : they find that the addition of alum and salts of tin to the destroying acid has no good effect, and greatly interferes with the subsequent dyeing operations ; that the draining in the centrifugal machine cannot safely be dispensed with ; and that the following limits of heat, proportion of acid, and time of action cannot safely be exceeded :—If the stove is at 80° C., and the goods are to be heated two hours, the acid may run from $1\frac{1}{2}$ to $4\frac{1}{2}$ litres for 100 of water ; if it is to be heated only half an hour, the acid may range from 3 to 7 litres. If the stove is at 110°, the acid is 1 to 3 litres per cent for two hours, and $1\frac{1}{2}$ to $4\frac{1}{2}$ for half an hour. If the heat is 150°, the acid should be $\frac{1}{2}$ to 1 litre per cent for two hours, and 1 to $1\frac{1}{2}$ litres for half an hour. Very prolonged washing with hot water, alkaline solutions, and cold water, is required to remove all superfluous acid after the burls are destroyed. Without great care the nature of the wool is affected, and its affinity for dyes enfeebled.

Researches on Erbium and Yttrium.—P. T. Clève.—The author has examined the ammonio-carbonate of yttrium, the potassio-sulphates of yttrium, the acetates of yttrium and erbium, the chloroplatinate of yttrium and of erbium, the chloraurates of both bases, the chloromercurate of erbium, the compounds of the sulphocyanates of both bases with cyanide of mercury, the basic nitrate of erbium, the formiates of yttrium and of erbium, the seleniates, potassio-seleniates, and ammonio-seleniates of both bases, the ammonio-sulphate and sodio-sulphate of erbium, and the sodio-carbonate of erbium.

Transformation of Toluene into Orcine and Orceine.—Vogt and Henninger have patented the following process :—Toluene, or monochlorated or monobromated toluene, is treated with concentrated sulphuric acid, so as to produce a sulpho-conjugated acid, or a monochloro- or bromo-sulpho-conjugated acid of toluene, mixed with excess of sulphuric acid. To this mixture lime and chalk are added, which separate the excess of sulphuric acid as sulphate of lime. Or, in order not to lose any sulphuric acid, the product may be allowed to act upon common salt. Hydrochloric acid is evolved, and the residue contains sulphate of soda and the sulpho-conjugated acids of toluene. Water is added, and the liquid containing the conjugated acids is decanted, and is finally neutralised with lime. The solution contains the disulpho-toluolate or chloro- or bromo-cresyl sulphate of lime, which are transformed into sodic salts by means of the sulphate or carbonate of soda. These salts, dried and melted, with double their weight of soda or potash, either under pressure or in the open air, yield orcine and alkaline salicylates. The reaction takes place from 280° to 300°. The melted mass is dissolved in water, neutralised with hydrochloric or sulphuric acid, concentrated, and the alkaline salts crystallised out. The mother-liquor contains orcine, which—by treatment with ammonia, lime, and air—is converted into orceine, the colouring matter of orchil.

MISCELLANEOUS.

Royal School of Mines.—On Saturday last, July 4, a meeting of the Council of the Royal School of Mines was held at the Jermyn Street Museum, at which the reports of the examinations of the students connected with that Institution were received and considered, and the prizes awarded. The following gentlemen received the Diploma of "Associate of the Royal School of Mines :" —*Mining, Metallurgical, and Geological Divisions*—S. A. Hill and W. Saise. *Mining and Metallurgical Division* —R. Cowper, A. R. Guerard, and C. Lloyd Morgan. *Metallurgical Division*—W. Pearce. *Geological Division* —A. R. Willis and W. Frecheville. The two "Royal Scholarships" of £15 each for first year's students were awarded to Henry Louis and E. Fisher Pittman. H.R.H. The Duke of Cornwall's Scholarship was awarded to A. R. Willis, and the Royal Scholarship of £25 to W. F. Lowe. The Edward Forbes Medal and Prize of Books were awarded to A. R. Willis. The De la Beche Medal and Prize of Books to C. Lloyd Morgan. The Murchison Medal and Prize of Books to A. R. Willis.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improved means of, and apparatus for, taking photographs at night. Eugen Ernst Johannes Sell, Chancery Lane, Middlesex. October 10, 1873.—No. 3288. I have found that, if bisulphide of carbon is burned with peroxide of nitrogen, the light produced will act on photographic paper in the same way as sunlight. The bisulphide of carbon is kept in a lamp suitably constructed, and the peroxide of nitrogen being carried into the flame completes the combustion.

Improved combinations of ingredients for cleansing and bleaching wools and other suitable fibres and fabrics, paintwork, floors, casks, and other articles and utensils. William Alfred White, London Street, London. (A communication from Arthur Lloyd, Paris). October 11, 1873.—No. 3310. The compositions are as follows :—1st, 22 parts of dry carbonate of potash, 50 of sand free from alumina and iron, and 2 of charcoal. 2nd. 22 parts of dry carbonate of sodium, 70 of dry carbonate of potassium, 20 of silicate, and 1 of charcoal. 3rd. 1 part of silica, and 2 parts of chloride of sodium.

A new or improved process for plating, coating, or covering iron direct with silver or gold. Stanislas Louis Delalot, Southampton Buildings, Holborn, Middlesex. October 14, 1873.—No. 3322. The feature of novelty of this invention consists in plating or coating iron with silver or gold directly, and without the aid of copper, as now practised by electro-platers. In order to accomplish the above object, it is necessary to manufacture the iron according to the following formula :—To every 1000 pounds weight of iron rendered liquid by heat, I add 12 pounds of nickel and $\frac{1}{2}$ pound of manganese. The iron thus prepared may then be plated or coated with silver direct, by a silvering mixture composed as follows :—To every 100 pints or pounds weight of water, I add 2 ounces of azotate or chloride of silver (very neutral), 2 pounds of bicarbonate of soda, 6 ounces of cyanide of potassium or sodium, and 10 drops of cyanhydric acid. To coat iron prepared as above with gold direct, I employ a mixture composed as follows :—To every 100 pints or pounds of water, I add $\frac{1}{4}$ ounce of chloride of gold (neutral), $4\frac{1}{2}$ pounds of bicarbonate of soda, $1\frac{1}{2}$ pounds of pyrophosphate of soda, 1 ounce of cyanide of sodium, and 2 drops of cyanhydric acid. To silver or gild the iron with the foregoing mixtures, the iron must first be rubbed with the hand, and then immersed in a liquid composed as follows :—To every 100 pints or pounds of water, I add 1 pound of slaked lime. The iron after immersion is immediately placed in a bath, without being first dried, and subjected to the ordinary electro-metallo-plastic process, and in this manner and by these means I am enabled to coat iron direct with silver or gold.

Improvements in the manufacture of manure. Thomas Almond Metcalfe, Falsgrave, Scarborough, York, and William Massingham, East Stockwith, near Gainsborough, Lincoln. October 15, 1873.— No. 3329. This Provisional Specification describes grinding refuse fish with gypsum and vegetable charcoal or other absorbent or deodorising material : animal refuse or sea-weed may be treated in like manner.

Improvements in the means employed for treating sewage. John Towle, J.P., Oxford. October 15, 1873.—No. 3331. This invention consists in filtering the liquid sewage through beds of town refuse contained in pits or receivers, having perforated floors placed over a pumping-well or receptacle for the filtered sewage. The sewage is pumped from the well into a tank to be distributed where desirable by suitable hose and pipes.

NOTES AND QUERIES.

Separating Palmitin and Stearin.—I shall be much obliged if you can, in the next number of your journal, inform me whether any process is known whereby palmitin and stearin may be separated from each other with accuracy on a small scale, so as to allow of a quantitative determination.—A SUBSCRIBER.

THE CHEMICAL NEWS.

VOL. XXX. No. 764.

THE PARLIAMENTARY COMMITTEE ON THE ADULTERATION OF FOOD ACT.

In our last two issues we have commented on some part of the evidence laid before this Committee. We have now to examine the Report, in which it embodies the results of its investigations. In so doing, we must admit that our prevalent feeling is disappointment. The Committee "has held fourteen meetings and examined fifty-seven witnesses," and has, with a curious infelicity, out of all this mass of evidence selected for recommendation precisely the most injudicious and impracticable suggestions.

The present Act is spoken of with exemplary impartiality. It is said to have "done much good," and at the same time to have "inflicted considerable injury." We scarcely see that the former conclusion is borne out by the evidence. On the contrary, the very facts adduced show it to have been little more than a dead letter. Out of 171 boroughs and 54 counties, only 26 boroughs and 34 counties have appointed analysts. The articles of food mentioned are few—tea, milk, butter, bread, corn-flour "mixtures," wine, beer, and spirits. Sugar is overlooked, as also coffee, except it be included by implication under the head "mixtures." As for sauces, jams, pickles, and confectionery, the articles most likely to contain pernicious admixtures, they are not even mentioned.

Regarding tea, it is suggested that it should be examined on landing by the Customs, and that if "seriously" adulterated it should not be admitted for home consumption. Adulterations, we must here remark, are generally "serious." If slight in amount, they would prove unremunerative. Whether the seizure of sophisticated teas by the customs would be a protection to the consumer is doubtful. It seems to us that the dealers interested in the sale of such teas would set up operations on this side of the water.

The passage on milk is one of the least satisfactory portions of the whole Report. The Committee endorse very exaggerated views as to the variability of this secretion, based on the results of analysts, who, if not inaccurate, had not the advantage of employing the most modern methods. It appears that, the more the procedures of milk analysis are improved, the less variation is observed in the results. The "solids not fat" appear to be, practically speaking, a constant; being very little, if at all, greater in "strippings" than in ordinary milk. If we attend to this point, we shall find that the "first and last pint of milk which a cow gives at the same milking do not present all the differences" between a natural and a watered milk. Furthermore, milk, before reaching the consumer, may be safely presumed to have become, to a great extent, averaged.

In "mixtures," the Committee do not see that a statement of the proportion of each ingredient used could be any real protection to the consumer. They think that, "by using a lower quality of cocoa-beans, a pure article may be made at a lower price than some of the mixtures." Is any merchantable quality of cocoa-beans cheaper than Iceland moss, or than potato-starch?

We were not without hope that the sale of mixtures of

coffee and chicory would have been condemned, or that it would have been at least recommended that the respective proportions of the ingredients should be stated; but this matter has not, apparently, been considered worthy the notice of the Committee.

From the consideration of the various articles of food, the Report passes to a series of general recommendations concerning the amendment of the Act. The question as to whether special medical knowledge should be required of candidates has been shelved. Concerning the proposal to erect the Somerset House Excise Laboratory into an ultimate court of appeal in disputed cases, we have already expressed our opinion. The Committee speak of the "incompetence and inexperience of the analysts," and yet would set over their heads a few men who, save in excisable articles, have probably still less experience! We shall not attempt to calculate the number of "really competent analysts in this country." It is interesting that those who form a very low estimate always include themselves in the select minority. The Committee seem to have a vague notion that chemical analysis is an art, one and indivisible, which, when once learned, can be applied indiscriminately and with equal ease to all classes of bodies. As our readers well know, this is not the case. Whenever it becomes requisite to find the value of new groups of substances, new methods have to be discovered, verified, and improved. This is eminently the case with the analysis of food, which till lately was without trustworthy and accurate methods. Yet, if the recommendations of the Committee become law, the men who are successfully effecting these improvements will find themselves set aside, and their results disputed and over-ruled. Misfortunes, as we know, rarely come alone. Not only is Somerset House to be established as the final Court of Appeal, but it is proposed that "the Local Government Board should have the option of calling upon the analyst for a certificate of having passed an examination at the School of Chemistry at South Kensington!" Why this one school should be placed in such pre-eminence above all other chemical schools in the kingdom, public and private, we fail to see. Cannot a due knowledge of chemistry be acquired, *e.g.*, in the laboratories of University College, or of King's College, or of the Royal Agricultural College at Cirencester? Is not the University of Oxford providing increased facilities for chemical studies? Why, then, should the certificate of South Kensington be entitled to sole and exclusive recognition? Are those who have passed, perhaps in high honours, at these colleges, to present themselves for re-examination at South Kensington, which will always seek to give the preference to its own pupils? The effect of this proposal would be to constitute the head of the South Kensington School, for the time being, as the arbitrary and irresponsible ruler of the whole body of analytical chemists. Can any learned profession submit to such a position? We are quite of opinion that the competency of the public analysts should be duly tested. But this task should be entrusted not to any one man, no matter how high his standing, but to a board of independent chemists, so that the interests, the prejudices, and the crotchets of each may be over-ruled by his colleagues. We may add that food analysis has not been, by any means, the speciality of South Kensington. We should fear that an examination there would prove not so much a test of the practical skill of a candidate, as of his acquaintance with and approval of certain views on notation and nomenclature which are there in the ascendant. We call upon the members of other professions to put themselves, for a moment, in the place of chemists, and reflect how they would like such regulations? We do not think that more effectual means could be taken to exclude men of standing and experience than the adoption of these proposals. They will as certainly degrade, as Mr. Allen's scheme would raise, the profession. It is fortunate that a year must elapse before any Bill, based upon the Report before us, can become law. We hope that our friends will make

good use of the time, and take such steps as the interests of the profession and the good of the public demand. Such an opportunity for organisation as is now given may not re-occur; if the recommendations of the Report become law, it cannot. The close of the document is truly pathetic. The Committee "believe it will afford some consolation to the public to know that in the matter of adulteration they *are cheated* rather than *poisoned!*"

REMARKS ON A PAPER BY PROFESSOR OSBORNE REYNOLDS * "ON THE FORCES CAUSED BY EVAPORATION FROM AND CONDENSATION AT A SURFACE."

By WILLIAM CROOKES, F.R.S., &c.

PROFESSOR OSBORNE REYNOLDS, referring to my experiments on attraction and repulsion accompanying radiation, says that it is his object to prove that these effects are the result of evaporation and condensation. In my exhausted tubes he assumes the presence of aqueous vapour, and then argues as follows:—"When the radiated heat from the lamp falls on the pith its temperature will rise, and any moisture on it will begin to evaporate, and to drive the pith from the lamp. The evaporation will be greatest on that ball which is nearest to the lamp; therefore this ball will be driven away until the force on the other becomes equal, after which the balls will come to rest, unless momentum carries them further. On the other hand, when a piece of ice is brought near, the temperature of the pith will be reduced, and it will condense the vapour and be drawn towards the ice."

Professor Osborne Reynolds has tried an experiment with pith balls attached to a light stem of glass, and suspended by a silk thread in a glass flask. The exhaustion was obtained by boiling water in the flask, and then corking it up and allowing it to cool. The gauge showed an exhaustion of from $\frac{1}{2}$ to $\frac{3}{4}$ of an inch. The pith balls behaved exactly as I have already shown they do at that degree of exhaustion, heat repelling and ice attracting. It was found that the neutral point varied according to whether air was present with the aqueous vapour, or whether the vapour was pure water gas. Prof. Reynolds writes—"It appears as though a certain amount of moisture on the balls was necessary to render them sensitive to the heat. . . . These experiments appear to show that evaporation from a surface is attended with a force tending to drive the surface back, and condensation with a force tending to draw the surface forward."

It does not appear that Professor Osborne Reynolds has tried more than a few experiments, and these he says "were in reality undertaken to verify the explanation" above quoted. I have worked experimentally at the subject for some years, and the last experiment recorded in my note-book is numbered 584. From the abundant data at my disposal I can find many facts which tend to prove that Professor Osborne Reynolds's explanation of the phenomena has been arrived at on insufficient evidence.

In the first place, the presence of moisture, or of a condensable vapour, is not necessary. Besides pith, which from its texture and lightness might be supposed to absorb and condense considerable quantities of vapour, I have used movable indices of glass, mica, and various metals, and with a proper amount of exhaustion they all act in the same manner.

The following experiments bear directly on this point:— A tolerably thick and strong bulb was blown at the end of a piece of hard combustion tubing, and in it was supported a bar of aluminium at the end of a long platinum wire. The upper end of the wire was passed through the top of the tube and well sealed in: this was for the purpose of

trying some electrical experiments, which, however, do not bear upon the present point. The apparatus was attached to the Sprengel pump, and exhaustion was kept going on for about two days. During this time the bulb and its contents were several times raised to an incipient red heat. At the end of the two days' exhaustion the tube was sealed off, and the bar of aluminium was found to behave exactly as it would in a less perfectly exhausted apparatus, viz., it was repelled by heat of low intensity, and attracted by cold. A similar experiment was next tried, only water was placed in the ball before exhaustion. The water was then boiled away *in vacuo*, and the exhaustion continued—with frequent heating of the apparatus to dull redness—for about forty-eight hours. At the end of this time the bar of aluminium was found to behave exactly the same as the one in the former experiment, being repelled by heat of low intensity. A similar experiment, attended with similar results, was tried with a glass index. It is impossible to conceive that in these experiments sufficient condensable gas or vapour was present to produce the effects Professor Osborne Reynolds ascribes to it. After the repeated heating to redness at the highest attainable exhaustion (the gauge and the barometer being level for nearly the whole of the forty-eight hours), it is impossible that sufficient vapour or gas should condense on the movable index, to be instantly driven off by the warmth of the finger with recoil enough to drive backwards a heavy piece of metal.

Another argument against Professor Reynolds's explanation may be drawn from the varying position of the neutral point. The fact that the neutral point for platinum or brass is close upon a vacuum, whilst that for pith is so much lower, shows that the repulsion is not due to any recoil caused by condensed vapour leaving the surface under the influence of heat. Were it so more vapour would have to be present when platinum or brass was to be kicked backwards than when pith had to moved; but the contrary obtains in all cases. The rule seems to be—the greater the density of the mass moved the higher the neutral point.

I have worked with all kinds of vacua. That is to say, I have started with the apparatus filled with various vapours and gases—air, carbonic acid, water, iodine, hydrogen, &c.—and at proper rarefaction I find no difference in the results which can be traced to the residual vapour. A hydrogen vacuum seems neither more nor less favourable to the phenomena than does a water vacuum, or an iodine vacuum.

If moisture be present to begin with, it is necessary to allow the vapour to be absorbed by the sulphuric acid of the pump, and to continue the exhaustion with repeated heating of the apparatus until the aqueous vapour is removed. When pith is employed as the index, it is necessary to have it thoroughly dried over sulphuric acid before using it, and during exhaustion to keep it constantly heated to a little below its charring point, in order to get the greatest sensitiveness.

Professor Osborne Reynolds says—"In order that these results might be obtained it was necessary that the vapour should be free from air." I find that the results take place with the greatest sharpness and rapidity if the residual gas consists of nothing but air or hydrogen.

Professor Osborne Reynolds further says—"Mr. Crookes only obtained his results when his vacuum was nearly as perfect as the Sprengel pump would make it. Up to this point he had nothing but the inverse effects, viz., attraction with heat and repulsion with cold."

As a matter of fact, I can obtain repulsion by radiation at far higher pressures than would be inferred from this quotation. The true effect of radiation appears to be one of repulsion at any pressure, overbalanced when a gas is present by some unknown cause, possibly air currents but probably not. I have already explained that the barometric height of the neutral point, dividing attraction from repulsion, varies with the density of the substance on which radiation falls, on the relation which the mass

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bears to the surface, and on the intensity of radiation. By modifying the conditions it is not difficult to get repulsion by radiation when the apparatus is full of air at nearly the normal pressure of the atmosphere.

Professor Osborne Reynolds again says—" The reason why Mr. Crookes did not obtain the same results with a less perfect vacuum was because he had then too large a proportion of air or non-condensing gas mixed with the vapour." On this I would remark that the writer, before he explained how it was I did *not* get certain results, should have made sure that what he assumed to be a fact really was so. I have not the least difficulty in showing repulsion by heat in very imperfect vacuum, when mixed vapours and gases are present.

But assuming that Professor Osborne Reynolds's explanation may account for some of the repulsion at high pressures, and in the presence of aqueous vapour, this explanation cannot be satisfactory when the vacuum is approaching absolute. The repulsion by evaporation of condensed vapour should diminish as the vapour present diminishes, and should become *nil* in a perfect chemical vacuum. I have, however, abundantly demonstrated that in all cases after passing the critical point of no action, the repulsion by radiation gets more and more apparent; it increases in energy as the vacuum approaches perfection, and attains its maximum when there is no air or vapour whatever present, or at all events not sufficient to permit the passage of an induction spark.

From the construction of my Sprengel pump I am satisfied that the vapour of mercury is not present in the apparatus.

A further argument against Professor Reynolds's explanation is that the repulsion in a vacuum is not confined to those red and ultra-red rays of the spectrum which produce dilatation of mercury in a thermometer, excite an electric current between antimony and bismuth couples, and cause a sensation of warmth when falling on the skin, but that any ray—from the ultra-red to the ultra-violet— will produce a similar effect. It cannot be imagined that a ray of cold light, filtered if necessary through thick plates of alum, can instantly vapourise a film of moisture from a plate of metal on which it is caused to shine.

For my own part, I wish to avoid having a theory on the subject. As far as the facts have led me, I think that the repulsion accompanying radiation is directly due to the impact of the waves upon the surface of the moving mass, and not secondarily through the intervention of air-currents, electricity, or evaporation and condensation. Whether the etherial waves actually strike the substance moved, or whether at the boundary surface separating solid from gaseous matter, there are intermediary layers of condensed gas which, taking up the blow, pass it on to the layer beneath, are problems the solution of which must be left to further research.

<div align="center">ON THE</div>

FORMATION OF CERTAIN DOUBLE METALLIC SULPHOCYANIDES.

By WILLIAM SKEY.

PRELIMINARY to a more extended treatment of this subject, I beg to contribute the following brief notes upon it to your valuable periodical :—

It is well known that chlorides of mercury and gold bleach the red sulphocyanides of iron : these effects appear to be due to the formation of double sulphocyanides, for I find a very pale red coloured crystalline precipitate forms when strong solutions of chloride of mercury and red sulphocyanide of iron are mixed and allowed to be at rest for some time; these crystals are nearly insoluble in water, and contain mercury, iron, and sulphocyanogen in definite quantities.

Sulphocyanide of Iron and Mercury form in long black prismatic crystals from an etherial solution of red sul-

phocyanide of iron and a mercurial salt; these are nearly, if not quite, insoluble in cold water, but are bleached by it, and no doubt pass into the pale coloured salt previously described. This compound is soluble in alcohol or ether, but very insoluble in acetic acid. The crystals are best washed with this acid from extraneous matters in the course of their preparation.

Sulphocyanide of Iron and Gold can be obtained from its etherial solution by spontaneous evaporation. It is finely granular, and but feebly soluble in water, more soluble in alcohol or ether; it is nearly black. Chloride of platina also decolourises the red sulphocyanide of iron if time be allowed it. But I have not been able to obtain a definite double sulphocyanide from this solution, though without doubt one forms.

Sulphocyanide of Mercury and Cobalt can be obtained in small anhydrous crystals of such an intense blue colour as to appear almost black by reflected light. Another cobalt of this nature, except that it is of a paler blue, has been formed; it crystallises in prisms of some size. Both these salts are insoluble, or nearly so, in water; they are decomposed by perchloride of iron, the red sulphocyanide of this metal forming. By evaporating a solution of chlorides of mercury and cobalt with an alkaline sulphocyanide to dryness, a red double sulphocyanide forms, which is very insoluble in water. Nickel does not appear to form a compound with sulphocyanogen and mercury, hence a process for separating it from cobalt. I may state here, as being connected with this subject, that cobalt readily forms two varieties of insoluble sulphocyanides with the alkaloids, while nickel with difficulty forms one.

Sulphocyanide of Mercury and Molybdenum falls as a flocculent red substance when the red sulphocyanide of molybdenum is mixed with chloride of mercury (aqueous solutions).

The double sulphocyanide of gold and mercury can also be readily prepared and in a crystalline state. Mercury, indeed, appears singular in regard to the number of double sulphocyanides it may form an essential element of, for, besides these just described, there is an insoluble double salt of it with cadmium and one with zinc, which I have long since announced, and also one with chromium, described by M. Rœsler as a red compound, but which I think to be light pink.

Sulphocyanide of Platinum and Ammonium forms (as is no doubt known) in small anhydrous crystals derived apparently from the octahedron, also in long prisms and flat hexagonal scaly-like masses, when platino-chloride of ammonium is digested with an alkaline sulphocyanide till dissolved, and the solution thus obtained allowed to spontaneously evaporate. These salts, as are those of the potassium salt, are of a scarlet colour and bitter; but an ammonium salt of this kind has been formed which is of a brownish red colour, crystallises in cubes, is extremely insoluble in water, and tasteless.

Perhaps some one of your numerous correspondents would kindly furnish me with the composition of one or more of these salts, or refer me to where such may be found, as I do not find any of them mentioned in the works on chemistry at my command.

Aniline, I may state, can be substituted for potassium in these salts; the compound so formed is nearly insoluble in water, but is easily soluble in alcohol or ether. The sodium salt is very soluble in water and alcohol. Sulphocyanogen thus appears to imitate chlorine very closely in its deportment with platinum and the alkalies; indeed, generally its analogies with this element seem far more decided than is the case with any of the other compounds of cyanogen or even cyanogen itself, as I shall presently attempt to show. In connection with this, I may remark that, rather singularly, the equivalent of this radical (sulphocyanogen) is a number which is very nearly the mean between that of chlorine and bromine.

Colonial Laboratory of New Zealand,
March 6, 1874.

ON SOME CHEMICAL ASPECTS OF PHYSICAL GEOGRAPHY.

By ALEX. S. WILSON, B.Sc.

(Concluded from p. 16.)

II.

DURING the recent voyage of the *Challenger*, a discovery has been made, the significance of which must strike every one who gives the matter even a passing thought, but to those who possess a knowledge of chemistry or geology this discovery is of peculiar interest. I therefore make no apology for directing the attention of chemists to it; indeed I cannot refrain from expressing surprise that reference should not have been made before this to a disclosure which is certain to alter existing notions as to the origin of a large section of the rock-masses composing the crust of the earth.

Professor Wyville Thomson, who has charge of the expedition, in his "Letters from the Challenger" (*Good Words*, January, 1874), records that, in sailing from Teneriffe, off the West Coast of Africa, to St. Thomas, one of the outlying West Indian islands, the soundings indicated that the bottom of the Atlantic rose into a ridge about 300 miles west of Teneriffe, and that from this, where the depth was 1500 fathoms, it sloped gently down until at 750 miles west of Teneriffe it had sunk to a depth of 2950 fathoms. From this point to within 300 miles of Sombrero the depth was pretty constant, and for 1800 miles the explorers seem to have been sailing over what geologists term a plain of marine denudation.

A remarkable relationship was found to subsist between the depth and the character of the dredgings. When worked on the 1500 fathom ridge, the dredge brought up globigerina ooze, multitudes of minute shells, and fragments of coral, the whole, with the exception of a few siliceous sponges, being composed mainly of carbonate of lime. As the depth increased, the proportion of these shells regularly diminished, until in the deep water they had altogether disappeared, and the dredgings then consisted of a fine red mud which did not effervesce with acid. This red-coloured deposit of the silicates of peroxide of iron and alumina was met with everywhere all over this vast submarine plain—everywhere it had the same unmistakable appearance; it could not, therefore, be the fine sediment brought down by rivers and carried out to sea, slowly settling in deep water, for then it must have differed in different localities; the absence of currents, too, as well as the great extent of the deposit, precluded this view of its origin. Another remarkable feature of this area was the absence of those pelagic shells which are littered in such numbers over all other parts of the bed of the Atlantic.

How, then, was this gradual disappearance of shells to be accounted for? Why was it that on this red mud area the shells of those animals that frequent surface-waters were not found, since when these creatures die their shells must inevitably fall to the bottom? Whence came this enormous accumulation of impalpable clay?

Air dissolved by water is richer in oxygen and carbonic acid than the air of the atmosphere. In air collected from just above the surface of the sea, Lewy found, by volume—

Oxygen..	21·060
Nitrogen	78·886
Carbonic acid	0·054
	100·000

Every 100 vols. of sea-water hold, on an average, 2·8 vols. of air in solution, which, in the case of surface-water, has the following percentage composition :—

Oxygen	25·046
Nitrogen	54·211
Carbonic acid	20·743
	100·000

From these two analyses, it will be seen that the amount of carbonic acid in ordinary air is, to that in dissolved air, in the proportion of 54 to 20·743. But the ratio of the carbonic acid to the total amount of dissolved gases is greater in water taken from a depth than in surface-water, as the following table from Wyville Thomson's charming book, "Depths of the Sea," will show :—

Analysis of Air held in Solution by Sea-Water at Different Depths.

	Thirty Surface.		Twenty-four Intermediate.		Thirty-five Bottom.	
	Per cent.	Proportion.	Per cent.	Proportion.	Per cent.	Proportion.
Oxygen ..	25·05	100	22·03	100	19·53	100
Nitrogen ..	54·21	216	51·82	235	52·60	261
Carbonic acid	20·74	83	26·15	119	27·87	143
	100·00		100·00		100·00	

The thirty-five samples of "bottom" water were all obtained from depths considerably under 1500 fathoms, but the following is given as the composition of air dissolved at a depth of 1476 fathoms :—

Oxygen	16·68
Nitrogen	43·46
Carbonic acid	39·86
	100·00

If, to the depth of 3000 fathoms, the amount of carbonic acid keep on increasing, relatively to the other dissolved gases, in a ratio at all comparable with that indicated by the foregoing analyses, it is easy to see that water at this depth, under such enormous pressure, must be capable of dissolving a large quantity of those solid substances which, like carbonate of lime, are soluble in water containing carbonic acid. It is clear, too, on account of both the pressure and the amount of carbonic acid being less, that water near the surface must possess a much feebler solvent power than water at a great depth. This being the case, we should expect to find more lime-secreting organisms in the shallower than in the deeper parts of the ocean; now, as has been seen, this is exactly what was found by the explorers in the *Challenger*.

Under these circumstances, Professor Thomson concludes that this vast deposit of fine red clay is neither more nor less than the insoluble portion of myriads of shells, the residue, in fact, of a chalk formation now dissolved. It might have been supposed, apart altogether from this dissolving tendency of the sea-water, that the conditions as to temperature, light, &c., at these great depths would be altogether unfavourable to life, but such is not the case; even in the red mud life abounds, although there the capacity of the water for retaining lime in solution is greater than the animal's power of abstracting it. The creatures living on this area are, therefore, either destitute of a test, or where that structure is present it is membranous, siliceous, or else, like the tubes of the annelids, simply composed of the red clay. To be relieved of any erroneous notions as to the sterility of the sea-bottom, it is sufficient to see the curiously-sculptured shell of a microscopic foraminifer, "minute, but beautiful," or to examine one of those strange-looking organisms which the indefatigable efforts of our deep-sea explorers "have called like spirits from the vasty deep."

It appears, then, that just as the higher regions of the Alps or the Andes are buried beneath a pall of eternal snow, so the higher regions of the sea-bed are covered by a layer of greyish-white ooze, prolific in organisms whose vacated shells will one day form chalk; and just as at the edge of the snow-sheet the glacier melts away into a liquid ocean-seeking stream, so, where the chalky covering of the sea-bottom descends into submarine valleys, it dissolves into ocean, leaving behind it the red mud, like a terminal or bottom-moraine.

Suppose, now, that a geologist should come across an ancient ocean-bed undisturbed by volcanic eruptions, and undefaced by denudation, he should expect to find, on the higher levels, chalk or limestone of some sort, and as he descended into the lower plains, that the rocks would gradually lose their calcareous character, passing from chalk to argillaceous limestone, from that to a calciferous slate, and finally into slate containing no lime whatever.

There is every reason to believe that the fine red clay accumulation is but incipient slate-rock; now, though a number of contingencies render the composition of a highly metamorphosed rock uncertain, the analyses of such rocks may, in a general way, afford evidences of their origin. It may be worth while, therefore, to give the results of the analyses of some specimens.

Analyses of Slate-Rock.

	I.	II.	III.
Silica	64·32	58·80	40·40
Alumina	19·35	23·13	34·92
Ferrous oxide	—	4·18	10·28
Ferric oxide	8·07	—	—
Oxide of manganese ..	0·40	0·33	0·52
Ferric sulphide	trace	0·70	0·30
Lime	—	1·14	—
Magnesia	2·30	2·16	—
Potash	0·83	0·71	3·92
Soda	1·91	1·64	0·50
Phosphoric anhydride	0·54	0·38	0·84
Carbonic anhydride ..	—	2·88	—
Combined water, and organic matter .. }	1·87	3·90	7·90
Hygroscopic moisture	0·28	0·16	0·24
	99·87	100·11	99·82
Specific gravity ..	2·78	2·83	2·86

I. is roofing-slate from the celebrated Penrhyn quarries, near Bangor. It is of a reddish purple colour, devoid of micaceous or pyritaceous particles. It rings when struck, and easily grinds to an impalpable powder quite free from gritty grains.

II. is from Easdale (Hebrides), of a dark bluish grey, pre-eminently slate, colour. Its surface has a peculiar lustre or sheen. Mica is absent, but great numbers of pyrites cubes are disseminated through the rock. The cleavage surfaces of this slate have a remarkable wavy or wrinkled appearance, resembling the ripple-mark on a sandy beach. When broken across, it does not give an irregular fracture line, but breaks in much the same way as a sheet of calc-spar would; it thus possesses a kind of double cleavage or coarse crystalline structure.

III. is from Luss, on the banks of Loch Lomond, and is of a beautiful light green colour, which occasionally passes into a delicate blue; it has a silky lustre. Slates from this quarry are not so durable as those from Bangor or Easdale: I observed, too, that the parts of this rock in the bed of a stream had become nearly white, from the water dissolving out the protosilicate of iron to which the colour is due. For the analysis of this specimen, I am indebted to my friend, Mr. H. M. Drummond.

It will be seen from these analyses that one specimen contains about 2 per cent of carbonate of lime, whilst that substance is not present in the other two. The analyses of German slates given in Bischoff's " Chemical Geology," similarly show that a great number of slate-rocks contain no carbonate of lime, whilst a smaller number contain proportions varying from a trace upwards. In a specimen from Carnarvon I found a very considerable quantity. All these three rocks, although they differ widely in appearance, contain oxide of manganese. Now, curiously enough, corals brought up from a great depth were incrusted with a black coating, which turned out to be nearly pure oxide of manganese. This may be only a coincidence, but it seems so strange that it may fairly be suspected of pos-

sessing some significance. The quantities of phosphoric acid are likewise favourable to the view that at least a portion of these rocks had an organic origin. So far, then, as the analyses go, they are not unfavourable to the theory of the origin of slate rocks now advanced by Professor Thomson and his colleagues. If, then, the great bulk of these rocks be removed from the category of mechanically-formed, into that of chemically-formed, or of organic, rocks, it will appear that geologists have been in the habit of under-estimating the importance of organic processes as geological agents. We will no longer be able to affirm with confidence, of a single grain of the commonest materials found on the earth's surface, that it has not at one time or other been associated with the manifestation of those mysterious forces which we call living. Our globe therefore resolves itself into a great charnel-house or mausoleum. Man has been called a plagiarism from oxen and sheep, but his house, whether it be of mud or of marble, is equally a plagiarism from the deserted dwellings of the Invertebrata.

The tendency of modern geology has been to break down the well-marked divisions into which the older geologists were wont to parcel out past time. The old notion, which in some measure still clings to the terms Devonian, carboniferous, cretaceous, &c., was that of a distinct period in the history of the earth. Each of these epochs was conceived to have begun and closed before the succeeding era began. In this way the world was believed to have passed through so many stages, in each of which only rocks belonging to that particular formation were deposited anywhere on the earth's surface. Thus, all the rocks of the gneiss were thought to have been formed before the lowest of the Cambrian began to be laid down, similarly with the succeeding silurian and Devonian systems. Now, however, these terms are used without reference to time, and we think of systems, widely separated according to the old method, being formed simultaneously. The chalk age was formerly supposed to have come to an end at a period long prior to man's appearance on the earth, but the researches of Carpenter, Thomson, Huxley, and others have established the "continuity of the chalk," and shown that a fauna, very similar to, if not identical with, that of the chalk, inhabits the Atlantic at the present day. The discovery of this red clay seems to point to the continuity of those ages when slate-rocks were supposed to have attained a maximum, *i.e.*, of the Cambrian and silurian formations.

Chalk deposits and coral reefs are by a process of metamorphosis converted into crystalline limestone, and by the action of sea-water even into dolomite. Granite and other so-called primitive rocks have been shown to be in many cases only metamorphosed sedimentary strata, so that we are unable to say at what particular line the recurring cycles of geological operations began: nor on this account can we assert, except in the case of species which have become extinct, that the fauna of any preceding, differed from that of the present age.

When this red clay comes to be slate, the only traces of life it can exhibit will be derived from silica-secreting organisms of a low type, like those doubtful appearances in older slate-rocks which have been described as fossils. It is therefore altogether unwarrantable to regard this low type as the sole, or even prevailing, form of life during the time when these rocks were formed; nevertheless, there have not been wanting supporters of this view.

For aught, then, that geology can say, whilst the oldest rocks of Britain were being laid down in 3000 fathoms of water, far away silurian man may have been cultivating vines on the fertile slopes that flanked the volcanoes of the period.

Smoke and Fume Condensing Apparatus.—We understand that a model of the smoke and fume condensing apparatus manufactured by Messrs. Heslop, Wilson, and Budden, may be seen at the Royal Polytechnic Institution.

OBSERVATIONS ON THE SPECTRUM OF SHEET LIGHTNING.

By J. W. CLARK.

On Thursday evening (July 9) the sky was rather cloudy, and soon after nine I noticed the first sheet lightning, which continued without much cessation until half past eleven. My observations were made with one of Browning's five-prism direct-vision pocket spectroscopes, the results of which are as follows :—Most flashes exhibited only a bright continuous spectrum, whilst a few showed only the central part of the spectrum. The spectrum of one flash I observed consisted of only the red end of the spectrum, which was traversed with three or four bright bands. Prof. Kundt, from his observations on the spectra of lightning, states that, whilst sheet lightning yields a spectrum of bands, forked lightning generally gives a spectrum of lines. Although a large number of observations were made throughout the evening, only in the above instance was a spectrum exhibiting bands observed with any degree of certainty.

ON THE
ACTION OF CARBON DISULPHIDE
ON THE
HYDRATES OF CALCIUM, BARIUM, MAGNESIUM, AND ZINC.

By DAVID WALKER.

When milk of lime is agitated with carbon disulphide, and then allowed to stand for a day or so, a bright orange-coloured irregular needle-shaped crystals are formed, which after the lapse of a few months will have accumulated in considerable quantities. Upon subjecting these crystals to analysis, the author found them to have a composition closely approximating to that required by the formula $CaCS_3.2CaH_2O_2+6H_2O$.

Basic calcium sulphocarbonate is quite insoluble in carbon disulphide and alcohol, but dissolves to a small extent in cold water, yielding an orange-coloured solution, which is decomposed on heating. Upon treatment with dilute sulphuric, nitric, hydrochloric, or acetic acids, it is decomposed, and yellow oily drops of sulphocarbonic acid, $(CS_3)''H_2$, separate, which decompose very rapidly.

Barium and magnesium hydrates yield soluble yellow compounds with carbon disulphide.

Zinc hydrate is not acted upon by carbon disulphide even after the lapse of many weeks.

THE
INTERNATIONAL AGRICULTURAL EXHIBITION AT BREMEN.

A special and distinctive feature of this most instructive and successful Exhibition, just closed at Bremen, is the interest and the hearty co-operation shown by the German agricultural chemists : for the first time an agricultural exhibition has been something more than a mere show of live-stock, vegetable products, and agricultural implements. A whole section was reserved for " Results of Scientific Enquiry," and a meeting of agricultural chemists, physiologists, and directors of experimental stations, formed part of the programme.

Germany has many of these agricultural " Versuchs Stationen,"—experimental stations, similar to Messrs. Lawes and Gilbert's agricultural laboratory at Rothamsted ; they all have been for the purpose of advancing agriculture by practical experiments and scientific investigation, which they do by following up special branches, such as physio-

logy of animals and plants, physics and chemistry of soils, solution of technical questions, cultivation of vines, analysis of manure, seeds, fodder, &c.

At the Exhibition, fourteen of these stations were represented, who had formed their separate contributions into one collection, presenting themselves to the visitor as one exhibitor. They have modestly declined the acceptance of any prize in the shape of money or medals, but, when the Bremen Senate offered them a special prize, consisting of £75 worth of choice wines from the celebrated Rathskeller, the men of science yielded, and gladly accepted the well-merited distinction.

Much as these stations may differ in their tendency or in the special objects pursued, they all have one thing in common—a well-appointed chemical laboratory, which fact is well illustrated by the variety of chemical apparatus exhibited.

A complete collection of all works ever published on agriculture, and another of the periodical agricultural literature, open the lists of exhibits to which I wish to draw attention.

From the many subjects interesting to the chemist, I select plans of laboratories, steam apparatus, small gas-works, attached to the stations ; apparatus for special purposes, such as distillation, titration, determination of nitrogen in manures, of fatty matter in milk and foods ; arrangement for disintegration, such as crushing, grinding, pounding, &c. ; presses ; hot-air, water-, and oil-baths ; safety furnaces for heating substances in sealed tubes at high temperatures, &c. Special attention is claimed for a travelling apparatus for analysis of stable air, for another demonstrating the conditions of ventilation in closed rooms, and for yet another for determining the porosity of building materials by ascertaining the amount of air forced through them.

The balance is well represented form the ordinary to the most delicate and most sensitive instrument. Sartorius, of Gottingen, exhibits a balance with an entirely new application of *torsion*, which simplifies the weighing, and does away with the "rider" altogether ; the present arrangement is open to improvement, but the idea itself is a most happy thought, and, when fully worked out, is sure to be universally adopted.

The section " Physiology of Plants" contains a model of cases for vegetation experiments with different manures, photographs of plants grown in aqueous solutions of alimentary substances, showing the effect of the various agencies ; other photographs represent the difference produced by feeding plants with salts containing the same radical but different acids, such as sulphates, nitrates, chlorides, &c.

A collection of " Adulteration of Seeds" forms another interesting subject. Prof. Nobbe, of Tharandt, first drew attention to this important point, which has been thoroughly exposed by many of the stations. There is a sample of beautifully got-up pure sand, carefully washed, sieved, and coloured, sold by a Hamburg firm some time ago as " clover-seed " at 13s. 6d. a cwt ; also collection of seeds of weeds used for adulteration, and showing properties of pure seed and admixtures.

I must pass by the valuable section " Physiology of Animals " to say a few words on the chemical meeting. At this meeting of agricultural chemists, physiologists, and directors of experimental stations, Dr. Fleischer, of Gottingen, explained a diagram showing the movement of albuminous matter in the body of an ox, clearly demonstrating the influence of food upon the accumulation of albumen. Prof. Müller proposed in such diagrams to adopt the same colour for always the same group of substances, such as red for blood-forming compounds, blue for hydrocarbons, reminding of the iodine reaction with starch, yellow for fatty substances, and green for chlorophyll, &c.

Dr. Cannstend reported on Prof. Neubauer's experiments on " bleeding of vines," at Wiesbaden, in the course of which he collected 213 litres of vine sap, which on analysis

gave, besides the salts of the soil, the whole series of organic acids from carbonic to succinic, malic, and tartaric acid ; these experiments result in most important hints as to the proper time of cutting the vine, and are therefore of really national importance to all vine-growing countries.

Prof. Nobbe gives in a large diagram information on the agricultural establishments of different countries, with many details of the German ones. From this diagram, it appears Germany has 39 stations, assisted by an annual Government grant of, on the average, £400 each ; many are self-supporting by analyses of soils, manures, &c., employing altogether more than 100 scientific chemists. The other countries are as follows:—Austria, 5 ; Belgium, 1 ; Italy, 12 ; France and England, none—the last only two private establishments.

Prof. Kühne shows a graphic illustration of influence of food upon milk as to quantity, percentage of solid matter, sugar, fat, albumen.

Prof. Wilheus has prepared a concentrated tincture of rennet, 1 c.c. of which coagulates 2 litres of milk.

Living plants grown in aqueous solutions of salts are shown, by which arrangement not only the growth of the underground parts may be watched, but also the require-ments of the plants may be controlled, and most interesting pictures are given of the influence of the various substances, or rather of the more or less stunted growth of the plants owing to the absence of a given substance. The pease-plant is shown in all stages, from the poor, starving, little plant to the strongly-developed creeper in full blossom and ripe shells, 6 feet high. There are poisoning cases of clover-plants grown in pots, and fed with English am-monia manure containing sulphocyanide of ammonium.

Finally, I may draw attention to several products obtained from the washing of wool; among them are crystals of iodine, and, from a large establishment in Bohemia, the fat or oil, which is there converted into gas to light up the factory.

This rapid sketch will suffice to show that the chemical and physiological part of this agricultural exhibition was by no means despicable, and, as I think this fact should not be lost sight of in England, I have drawn up this short account, omitting many points which I should have wished to touch upon, as I am afraid I have already un-reasonably drawn upon the space in your journal.

F. V.

NOTICES OF BOOKS.

Elementary Chemistry. By Dr. BERNAYS. London: Christian Knowledge Society.

THE book opens with the widest definition of chemistry we remember to have seen :—" Chemistry is that branch of science, or knowledge, which is concerned with the nature and properties of matter." A novel feature is the introduction into the remarks on carbon of as much organic chemistry as is compatible with the elementary character of the work. The most familiar substances of daily life are commonly of organic origin, and a slight knowledge of their nature is essential to even a rudimentary acquaint-ance with the science. The author has boldly faced the difficulties of modern theory to beginners, and we think with considerable success. A great many interesting and some new facts are given in the course of the work, which is altogether one of the most useful and readable of the cheap manuals of elementary chemistry that have yet appeared. It is fairly illustrated.

School of Mines, Columbia College.

IN these days when industrial rivalry, if not substituted for, is supperadded to, the old warlike antagonism of nations, documents like this cannot be read without a lively interest. The School of Mines, whose arrange-

ments are here described, is fully and admirably organised. In those departments with which we feel especially con-cerned, it has a professor of mineralogy and metallurgy ; a professor of analytical and applied chemistry ; a professor of general chemistry ; a professor of physics ; a professor of geology and palæontology ; four assistants in analytical chemistry ; an assistant in assaying ; an assistant in gen-eral chemistry ; an assistant in geology ; and an assistant in mineralogy. There are five parallel courses of study—civil engineering ; mining engineering ; metallurgy; geology and natural history ; and analytical and applied chemistry. In the three latter departments proficiency is rewarded at the end of the three years course with the diploma of Bachelor of Philosophy. The studies prescribed are ex-clusively scientific, no literary qualification being insisted on, save a knowledge of French and German. These languages are required merely that the candidates may be able to avail themselves of the scientific and technological literature of France and Germany.

Versuche uber die Bedentung der Aschebestandtheile in der Nahrung. Von Dr. I. FORSTER. München: Schurich.

THIS work is an enquiry into the functions of the mineral constituents of food. The author concludes from his ex-periments that the animal organism maintained in other respects in equilibrium, requires for its maintenance a supply of certain salts. If this supply falls below a certain amount, or ceases altogether, the system loses salts, and consequently perishes. If the mineral ingredients are withdrawn as far as possible from the diet of an adult ani-mal, the processes of the transformation of matter, and of decomposition in the body, go on in the same manner as if ash-constituents were present in the food along with the other necessary ingredients. Gradually, however, disturb-ances arise in the functions of the organs which, on the one hand hinder the conversion of the food into modifica-tions capable of assimilation, and consequently prevent the replacement of the decomposed particles of the body ; on the other hand, they determine the destruction of the organism by the suppression of processes essential to life. The minimum of saline matter required for the main-tenance of health was not determined. The analysis of articles of food may easily lead to exaggerated notions of the quantity of mineral matters requisite. Milk, *e.g.*, con-tains mere traces of iron, and yet it yields all that the young animal requires for the formation of its rapidly in-creasing mass of blood.

CORRESPONDENCE.

DOES SUNSHINE CHECK COMBUSTION ?

To the Editor of the Chemical News.

SIR,—This question is occasionally raised, and, in the opinion of many persons, an extinguishing effect is really attributed to direct sunshine upon the domestic fire. A friend who has spent some years in South America informs me that the Indians of the Pampas will light their fires in the shade on this account, and to obtain it they will, in the absence of trees, strike tall thistle-stalks into the ground, and place a saddle-cloth over. As the habits of the Indians are generally founded on close observation, this fact may deserve attention.—I am, &c.,

G. A. KEYWORTH.

July 14, 1874.

Bleaching Bones and Ivory.—M. Cloez.—Bleaching is effected by exposure to the sun for three or four days in tanks filled with oil of turpentine. The objects must be supported on zinc stages at the height of a few millimetres above the bottom of the tanks.—*Les Mondes.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, May 25, 1874.

Note on the Movement of a Conical Pendulum, regard being had to the Resistance of the Air.—M. Resal.

Solar Radiation.—M. Desains.—Suppose a narrow valley enclosed between high mountains. From simultaneous hygrometric observations at the bottom, on the sides, and the summit of the mountains, the average hygrometric state of air in the valley may be ascertained, and so the mean weight of vapour in a given column of this air. If, at the same time, observation be made of the intensity and transmissibility of solar radiation at the bottom of the valley and on the tops of the mountains, we may deduce from these the double influence experienced by rays in their passage through an air layer of known weight, and containing a known quantity of vapour. Repeating these observations with different hygrometric states, but with the same height of the sun above the horizon, it will be possible to construct hygrometric tables, by means of which, from differences observed in the transmissibility of solar rays, we may deduce those of the total weight of aqueous vapour which the atmosphere contains in a given direction. At Paris, for nearly equal thicknesses of atmosphere, the author has found the transmissibility of solar rays vary from 0·55 to 0·77. The variations are greater than those obtained by interposing a layer of water 0·01 m. thickness in the path of direct rays.

Studies on the Transformation of Iron into Steel.—M. Boussingault.—(Extract from memoir.) The author sought to determine wherein blistered steel (the product of cementation) differed from iron; the nature and quantity of substances acquired or lost by the metal during cementation. The increase of weight in the cemented bars exceeded the weight of carbon fixed. This difference is probably due to some substances (silicium, phosphorus, &c.) from the charcoal ashes. A small quantity of iron is eliminated in the state of chloride, which is found in the charcoal. Cast steels, considered of superior quality, are really formed of iron and of carbon. In proportion as their quality rises we find the sulphur diminish and disappear. They are generally free from phosphorus; and manganese, like silicium, is present in a proportion rarely exceeding 1-1000.

Remarks by M. Berthelot.—He remarked on the *rôle* of hydrogen and of carbon in the manufacture of steel. Does not the hydrogen seem to form with the iron a combination analogous to hydrogenised palladium and the hydrides of alkaline metals lately studied by MM. Troost and Hautefeuille? and may not the graphite, which is so distinctly separated at certain points, arise from some definite compound of carbon and of iron formed on contact of these two elements, and by their direct union, like acetylen? The carburet of iron might arise from a carburet of hydrogen formed and then continually regenerated, which might act as intermediary in fixation of carbon, the iron being substituted for the hydrogen directly, as potassium, sodium, and magnesium have the property of being substituted for hydrogen directly in acetylen. The carburet of iron thus derived would explain the predominant *rôle* of carbon in steel production, a *rôle* restored to it by M. Boussingault's observations. The reactions which make one suspect the formation of hydride of iron commence at red heat, *i.e.*, nearly the same temperature as that at which hydrogen, usually inactive at ordinary temperatures, becomes a very active element, apt to combine directly with oxygen to form water, or with sulphur to form sulphydric acid; or with alkaline metals to form

hydrides; or, lastly, with carburets of hydrogen, ethylen especially, to form hydrides also with them. All these hydrides, water excepted, take rise under the conditions of dissociation. The relation of these phenomena is of interest for chemical mechanics.

Observations on the Spectrum of Comets.—P. Secchi.—Winnecke's comet gave three bands, one in the green-blue, one in the green, and the third in the green-yellow, the first the brightest. They seemed in the position of the bands of other comets, but he could not measure rigorously. He observed Coggia's comet on May 16 and 17. The spectrum was of bands; two were very bright in the green and green-yellow, and corresponded to bands of carbonic oxide and carbonic acid. It is remarkable that all comets hitherto observed have given carbon bands. The author goes on to say he has been further confirmed in his opinion that the line 1474 of the solar corona does not belong to iron. Watching a magnificent eruption one morning, he saw the line reversed throughout the width of the spectrum, while the two lines of iron near it were reversed only throughout a very small length, and in a hardly perceptible manner. If all three lines were of iron they should be reversed throughout the same extent. The line of the corona perfectly resembled the lines of the chromosphere; it had the same intensity at a great distance from the border, and for an extent of 24°, while the lines of iron were very bright only in a small jet. P. Secchi then calls attention to an observation on one of Jupiter's satellites. When the satellite, approaching the disc, was distant from it by about its own diameter, the disc seemed to dart out so as to meet it, then immediately withdrew again. This to-and-fro movement lasted till the satellite had clearly eaten into the planet, or during four or five minutes. The satellite appears (in relation to it) as an immovable point; the movement is all on the planet's side. This atmospheric oscillation might interfere with the transit observations, and Secchi thinks it desirable to adopt some method which would diminish it, such as his spectroscopic method.

Vidal Ebullioscope.—M. Malligand and Mdlle. Brossard-Vidal.—Sugar, resins, citric and tartaric acids do not alter the boiling-point of alcohol in which they may be dissolved. This observation, made by the Abbé Brossard-Vidal, was the basis of an instrument he devised for determining the richness of alcoholic liquids. An improved form of it is here described. The indications can be had with a small quantity of the liquid (70 c.m.) and rapidly (in nine minutes).

Movement of Air in Tubes.—M. Bontemps.—(Third note.) The author here carries on the analogy to flow of electricity in a wire, applying Ohm's law.

Researches on Germination.—MM. Deherain and Laudrin.—The condensation of gases by seeds the authors find demonstrated—(1) by the existence of a small quantity of free nitrogen in them; (2) by liberation of this gas in experiments of long duration; (3) and especially by the diminution of volume produced in a confined atmosphere during the first period of germination. Now this rapid condensation by a seed of ten to fifteen times its volume of gas cannot occur without the gas losing latent heat; and it is precisely this heat which raises the temperature of the occluded oxygen to a degree sufficient for the phenomenon of oxidation to begin. The agitation is communicated to the whole mass, and the heat liberated by the combination favours a new action manifested liberation of carbonic acid.

Ammonia and Phenate of Ammonia in Treatment of Cholera and Zymotic Disease, apropos of Serpent Bites.—Dr. Declat.—The author states that ammonia and its various salts, in addition to their anti-fermentative action, fluidify the thickened blood in zymotic disease. The combination of ammoniacal gas with phenic acid, taken in draught, and subcutaneously injected (in proportions Dr. Declat specifies), is the best medicament for confirmed cholera.

New Mineral Species from the Province of Lerida.
—M. Ducloux.—The author has given the name rivotite
to a mineral found in small irregular masses, disseminated
in a yellowish white limestone, on the western slope of
the Sierra del Cadi, in the province of Lerida. The
mineral is compact; its colour varies from a delicate
yellowish green to a deep greyish green. The colour of
its powder is grey-green. It is amorphous, of stony
appearance, quite opaque, and of unequal fracture. Its
hardness is between those of arragonite and fluor-spar.
It is very brittle, and its specific gravity varies from 3·55
to 3·62. In almost all large specimens patches are found
of green fibrous carbonate of copper. Before the blow-
pipe rivotite presents the following characters:—A middle-
sized fragment, heated in the platinum forceps, decrepitates,
but a small fragment melts and colours the outer flame
green. If heated alone upon charcoal in the reduction
flame it melts, forming metallic globules. No arsenical
odour or antimonial vapour is perceived, and the charcoal
is not coated with any characteristic deposit. If heated
in a test-tube it blackens, gives off carbonic acid, and a
little hygroscopic water neutral to test-paper. In a tube
open at both ends the reactions are the same. With car-
bonate of soda upon charcoal, in the reduction-flame, it
produces an opaque mass which, upon a plate of silver,
does not offer the reactions of sulphur. Upon platinum
wire, with borax or phosphorus salt, it dissolves with
effervescence, producing the characteristic reactions of
copper in both flames. The quantitative analysis yielded,
in 1 grm.—

Oxide of copper	0·3950
Carbonic acid	0·2100
Oxide of silver	0·0118
Antimonic acid	0·4200
Lime	traces
	1·0368

It approaches more nearly to selbite than to any known
mineral.

**Action of Sulph-urea and Bisulphide of Carbon
upon Argentic Urea.**—J. Ponomareff.—This paper has
been already noticed in the CHEMICAL NEWS.

Bulletin de la Societe Chimique de Paris, tome xxi., No. 9,
May 5, 1874.

Preliminary Notice on Pimaric Acid.—M. A. Cailliot.
—The author describes the crystalline form and optical
properties of pimaric acid, and its resolution into three
parts on its alcoholic solution being raised to the boiling-
point, viz., dextro-pimaric and pyro-pimaric acids, and
certain intermediate products, which he reserves for fur-
ther examination.

Bromo Derivatives of Pyruvic Acid.—E. Grimaux.
—A lengthy paper, not suited for abstraction.

**Action of Chloride of Trichloracetyl on the Amines
of the Aromatic Series.**—D. Tommasi and R. Meldola.
—The authors examine the action of the chloride of tri-
chloracetyl upon phenylamin.

Action of Chloride of Benzyl upon the Camphors.
—Donato Tommasi.—The author examines the action of
chloride of benzyl upon the camphor of the laurel tribe.

**Examination of Combustibles from the Basin of
the Donnetz, and of Toula (Russia).**—A. Scheurer-
Kestner and Ch. Meunier Dollfus.—The lignites in ques-
tion contain, in comparison with coal, large amounts of
ash, and of oxygen and nitrogen, which are unfortunately
grouped together.

Action of Bromine on Bibromo-Succinic Acid.—
M. A. Edme Bourgoin.—The bodies obtained are tribromo-
succinic acid, bibromo-maleic acid, and hydride of tetra-
bromated ethylen.

**Facts Relative to the Etherification of Ordinary
Glycol.**—M. Lorin.—Formic acid combines directly with
glycol. On distilling the formic acid obtained by

saturating the glycol with oxalic acid, the monoformin,
and especially the diformin, of glycol are met with.

Formins of the Polyatomic Alcohols—M. A. Hen-
ninger.—A reply to the preceding notice.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé
Moigno, No. 18, April 30, 1874.

Action of Chloroform upon Petroleum.—The ad-
dition of 1 part of chloroform to 5 of petroleum renders
the mixture incapable of combustion until the former body
has been evaporated away. A litre of burning petroleum,
spread out over a surface of 10 square centimetres, is
extinguished by throwing upon it 50 c.c. of chloroform.

Artificial Alizarin and Madder Alizarin. — M.
Chevreul.—The extension of the production of artificial
alizarin must cause a loss of 30,000,000 francs to the
commerce of France. For reds and rose shades, *fleur de
garance* is still preferable to artificial alizarin. For violets,
the shades produced by artificial alizarin are as good as
those from *fleur de garance*, and are more economical. As
regards fastness, the advantage is on the side of the
natural product, but the difference is not sufficient to
exclude artificial alizarin.

Tome xxxiv., No. 1, May 7, 1874.

The Dangers of Methylated Spirit in the Arts.—
The author enumerates a variety of symptoms produced
in workmen who are exposed to the fumes of methylated
alcohol.

Poisoning by Nitrobenzol.—A case of poisoning from
the external use of this compound, described by Dr.
Limasset.

No. 2, May 14, 1874.

Mineral Manure.—A paper on the bituminous schists
of the lias, said to have the power of determining the
formation of ammonia and of nitric acid from the elements
of air and water.

No. 3, May 21, 1874.

Presence of Arsenic.—Hager recommends the follow-
ing method for the detection of arsenic in paper-hangings.
A slip of the paper is steeped in a concentrated solution
of nitrate of soda in a mixture of equal parts of alcohol
and water, and allowed to dry. It is then burned in a
porcelain capsule, water is poured upon the ash, an excess
of potash is added, and the whole is boiled and filtered.
Dilute sulphuric acid is added to the filtrate, and then
permanganate of potash, which is dropped in slowly till
the red colour disappears, giving place to a yellow under
the influence of heat. If the liquid is turbid, it is filtered
afresh. It is then cooled, placed in a bottle, more sul-
phuric acid is added, as also a small piece of pure zinc,
and the bottle is closed with a stopper having two slits.
In one of these is placed a piece of paper steeped in
nitrate of silver, and in the other a slip of parchment
soaked in sugar of lead. If arsenic is present, the former
speedily blackens. The parchment serves merely for the
detection of sugar of lead.

New Acid Extracted from Aloes.—Weselsky melts
aloes in caustic alkali, dissolves in water, acidifies with a
few drops of sulphuric acid, treats with ether, evaporates
to a syrup, re-dissolves in water, treats with acetate of
lead, filters, precipitates the lead with sulphuretted hydro-
gen, and saturates with carbonate of baryta to separate
orcine. The baryta is then thrown down with sulphuric
acid, and the mass remaining upon the filter is treated
afresh with ether. The mother-liquor contains the acid
in question.

MISCELLANEOUS.

Centennial of Chemistry, 1774—1874.—In our last
issue we referred to the proposed meeting of American
chemists to commemorate the discoveries of Dr. Priestley,
Scheele, and others in the year 1774. A circular, from

which we make the following extracts, has been forwarded to us from Dr. H. Carrington Bolton, the Chairman of the General Committee:—"The one-hundredth anniversary of Priestley's brilliant discovery now drawing rapidly near is worthy of a commemorative ceremonial, and the fact that this illustrious man spent the last years of his fruitful life in this country renders the recognition of his work by American chemists peculiarly appropriate. A *reunion* of American chemists for mutual exchange of ideas and observations would, it is believed, foster a feeling of fraternity among us, and is considered by the undersigned eminently desirable. The approaching centennial affords a fitting occasion for such a gathering. We therefore invite the chemists of America to meet at Northumberland, Pennsylvania, where Priestley lies entombed, on July 31, 1874, to celebrate by appropriate exercises this memorable epoch in the history of chemistry. Signed,—George F. Barker, Frederick A. P. Barnard, James C. Booth, G. J. Brush, G. C. Caldwell, Charles F. Chandler, William H. Chandler, J. P. Cooke, jun., Henry H. Croft, Silas H. Douglas, Henry Draper, John C. Draper, John W. Draper, Frederick A. Genth, Wolcott Gibbs, Charles A. Goessman, S. Dana Hayes, Benjamin S. Hedrick, Joseph Henry, Eugene W. Hilgard, Eben N. Horsford, T. Sterry Hunt, Samuel W. Johnson, Charles A. Joy, H. L. Kendrick, Albert R. Leeds, Abram Litton, John W. Mallet, Henry Morton, Henry B. Nason, John M. Ordway, Ira Remsen, Robert E. Rogers, Charles A. Seeley, Benjamin Silliman, J. Lawrence Smith, and Henry Wurtz. *Circular from the General Committee.* —Northumberland is situated at the junction of the north and west branches of the Susquehanna River, about sixty miles north of Harrisburg. The scenery in this region, always picturesque, is at this point exceedingly beautiful, and those visiting Northumberland will be fully repaid by the beauties of Nature alone. A short distance from the town, in a hillside cemetery, charmingly located, lie the remains of Joseph Priestley; the house he built, and in which he died, is in perfect preservation, and many relics of him are found in the town. The memorial exercises have not been definitely arranged, but it is expected that they will include—(1) An Address, by Professor Joseph Henry; (2) A Sketch of the Life and Labours of Joseph Priestley, by Professor Henry H. Croft; (3) A Review of the Century's Progress in Theoretical Chemistry, by Professor T. Sterry Hunt; (4) A Review of the Century's Progress in Industrial Chemistry, by Professor J. Lawrence Smith; (5) An Essay on American Contributions to Chemistry, by Professor Benjamin Silliman. In order to add to the interest of the occasion, a Loan Exhibition will take place during the meeting for displaying apparatus, books, manuscripts, &c., belonging to Dr. Priestley, or other objects illustrating the history of chemistry."

Metropolis Gas Supply.—Dr. Letheby, the chief Gas Examiner appointed by the Board of Trade, has recently reported to the Metropolitan Board of Works and the Corporation of London on the gas supplied to the metropolis by the Chartered, the Imperial, and the South Metropolitan Gas Companies, during the months of April, May, and June last. The examinations of the gas are made at nine testing-places in the metropolis every night, and the results thereof during the quarter were as follows:— The average illuminating power of the common gas of the Chartered Company was 17·39 standard sperm candles at Beckton, 16·95 candles at Cannon Street, and 17·08 candles at Friendly Place, Mile End; that of the Imperial Company was 16·77 candles at Carlyle Square, Chelsea, 15·82 candles at Camden Street, Camden Road, and 17·76 candles at Graham Road, Dalston; while that of the South Metropolitan Company was 16·53 candles. The cannel gas of the Chartered Company had an average illuminating power of 21·27 standard candles at Millbank, and 21·62 candles at Ladbroke Grove. Dr. Letheby reports that the gas of all the companies was fully equal to the requirements of the Acts of Parliament. As regards impurity, it is stated that the gas at all the testing-places has been constantly free from sulphuretted hydrogen, and

that, with few exceptions, the amount of sulphur has not exceeded the prescribed proportions. The average quantity of sulphur in the gas of the Chartered Company was 10·6 grains per 100 cubic feet at Beckton, 10·74 grains at Cannon Street, 8·87 grains at Friendly Place, 18·79 grains at Millbank, and 17·58 grains at Ladbroke Grove. In the case of the Imperial Company, the average amount of sulphur was 20·32 grains per 100 cubic feet of the gas at Carlyle Square, 15·93 grains at Camden Street, and 18·48 grains at Graham Road; while the amount in the South Metropolitan Company was 18·26 grains, and, on ten occasions, the gas of this company contained an excess of sulphur (above 25 grains per 100 cubic feet), which the chief Gas Examiner attributes to accidental causes. The proportion of ammonia in the gas at the several testing-places was at all times below the prescribed amount of 2·5 grains per 100 cubic feet, the average quantity being less than a grain per 100 feet.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in apparatus for the manufacture of alkali. Henry Deacon, Appleton House, Widnes, Lancaster. October 15, 1873.— No. 3336. This invention consists in giving the current of flame, smoke, and other products of combustion employed in the manufacture of alkali, an upward direction before they enter the "pan," combined with the opportunity of depositing dust, and the means of causing the gases to mix; and this is effected in the following manner:—The "pan" may be raised so that the surface of its liquid contents is above the level of the axis of the "revolver," and thus the current of smoke will have an upward direction just before entering the "pan," and the end of the "pan" next to the "revolver" may be shielded from the heat by a brick wall or otherwise, against which the current of smoke impinges, and is thus mixed, and a chamber may be left between such brick wall or substitute therefor and the "revolver," into which chamber dust may deposit.

Improvements in the manufacture of manures or fertilisers. John Berger Spence and Peter Dunn, merchants, Manchester. October 16, 1873.—No. 3356. This invention consists in methods of treating natural phosphates of alumina and iron, such as those of Redonda and Los Rosques, for the purpose of rendering them more valuable as manures or fertilisers.

An improved mixture for preparing farinaceous compounds for baking. Archibald Clark, biscuit manufacturer, Glasgow. October 21, 1873.—No. 3417. This invention has for its object to improve bread, biscuits, and other baked products formed from wheat-flour or other farinaceous compounds, and, according to one modification, about 18 lbs. of linseed are steeped in 100 gallons of water for several days, and there is then added to the mucilaginous albuminous solution or liquid thus obtained 1 lb. sodium bicarbonate, 1 lb. ammonium carbonate, and 1 lb. tartaric acid. The mixture thus formed is added to the flour or farinaceous matter in quantity to give the consistency required.

Improvements in producing or preparing indigo-blue dye. Thomas Dentith, manufacturing chemist, Manchester. October 23, 1873.— No. 3446. The nature of my invention consists, first, in treating indigo with caustic soda, or sodium hydrate, or potassium hydrate; then with sulphide of tin, or sulphite of tin, or hyposulphite of tin, or metallic tin, or metallic zinc, or metallic antimony, or proto-oxide of tin (or stannous oxide of tin); and afterwards treating the above with sulphurous acid, or hyposulphurous acid, or carbonic acid, or tannic acid, or any other suitable acid. Another part of my invention consists in treating indigo with soda-ash liquor or potash liquor, then with sulphite of tin or proto-oxide of tin (or stannous oxide of tin).

An improvement in the manufacture of spirits, and apparatus for the same. Patrick Griffin, Cork, Ireland. October 23, 1873.—No. 3450. This invention consists in exposing the spirit in a divided state to the action of the atmospheric air. According to one method, the manufactured spirit is contained in a vat placed at a considerable elevation, from which it is allowed to fall in drops into a receptacle below. The process may be used to reduce the spirit to the legal strength, instead of reducing it by dilution, as now practised, before putting it into bond.

NOTES AND QUERIES.

Separation of Salts.—How can I separate a mixture of Epsom salts, sulphate of potash, and common salt?—H. S. B.

TO CORRESPONDENTS.

S. W.—The subject has already occupied considerable space. Press of more important matter renders the insertion of your letter impossible.

J. Warren.—Order the journal of Messrs. Asher and Co., Bedford Street, Covent Garden.

A. Tween.—The paper is too hypothetical for our columns.

S. R. P., Demerara.—Our publisher desires us to state that the volumes you require are out of print.

THE CHEMICAL NEWS.

VOL. XXX. No. 765.

MEASUREMENT OF THE CHEMICAL ACTION OF SOLAR LIGHT.

By Dr. T. L. PHIPSON, F.C.S., &c.

THE method employed by Messrs. Bunsen and Roscoe having been recently called in question, as leading to an exaggerated conception of the amount of chemical energy in the solar rays, Marchand* has had recourse to an apparatus which is merely a modification of that invented in 1859 by my lamented friend, Nièpce de St. Victor. In this apparatus light acts upon a solution of ferric chloride containing an excess of oxalic acid, and the chemical intensity is measured by the volume of carbonic acid evolved.

Many years ago I made some experiments on this subject in Paris, and described a method† which I believe capable of giving more accurate results than any hitherto obtained. Having discovered that a colourless solution of molybdate of ammonia in sulphuric acid became greenish blue when exposed to the sun, and colourless again during the night, and, that the amount of chemical action exerted to produce this tint may be accurately determined by a dilute solution of permanganate of potash, it suffices to operate always upon the same quantity of substance, and to expose it to the light for the same period of time, and in every respect in the same conditions, in order to possess a perfectly accurate process by means of which the problem of the chemical intensity of solar light may some day be solved in a completely satisfactory manner.

DETERMINATION OF THE ZERO POINT.

By B. F. CRAIG, M.D.

IN the CHEMICAL NEWS, vol. xxvi., p. 249, an article is translated from a French chemical journal, on "The Determination of the True Zero of Thermometers." In it the fact is noted that thermometers almost always read a little too high; the cause of this error is set down to a systematic fault in the accepted method of determining the zero point, and a new method of procedure recommended, which, although ingenious, is troublesome and, I suspect, inaccurate.

That the method frequently used, and which the writer assumes to be always used, for determining the lower of the two fixed points of the thermometric scale, gives an erroneous result there can be no doubt; but this is the fault of the unsound manner in which an established procedure is carried out.

Following the inaccurate phraseology, "the freezing-point of water," which is used by most authors and lecturers, it is the habit to immerse the thermometer in water containing more or less broken ice. Now, the Centigrade zero, or Fahrenheit 32° point, is the temperature of the melting ice, and the water, unless in exceptional cases, is always somewhat above that temperature. If the thermometer bulb and stem is immersed in melting ice, or snow, from which the water is draining off as it is produced, the mercury will attain the exact temperature of the Centigrade zero, and will always be found to stand at the same height, as nearly as any means of observation can indicate.

I have had considerable experience in the matter, and I

* Marchand, *Journ. de Chim. et Pharm.*, [4], xviii., p. 417, 1873.
† Phipson, *Comptes Rendus*, Paris, 1863.

may state that any vessel filled with damp snow will give accurate results if the instrument is driven down in the snow up to the 32° point, and a lens placed on top of the snow to read by, provided always that there is no accumulation of water about the bulb.

Thermometers are found almost invariably to read too high, not because the original determination of the zero is always inaccurate, but because the changes which time effects in the bulb always tend towards its contraction, although there may be temporary changes in the other direction.—*American Chemist.*

PRODUCTION OF CERTAIN DOUBLE SALTS OF THE ANILINE BASES AND INDIGO WITH METALLIC SALTS.

By WILLIAM SKEY.

IN a late communication to your periodical, I showed that aniline forms a double sulphocyanide with platinum and sulphocyanogen. I have since extended my enquiries in this direction, and find that corresponding salts of the so-called aniline bases may also be formed, and, besides, several double salts of these bases with the fixed natural ones. Thus, acetate of mauveine, warmed with bichloride of platinum till the precipitate first formed is dissolved, gives a granular precipitate when mixed with sulphocyanide of platinum and a large excess of chloride of potassium or ammonium.

Acetate of rosaniline, under similar circumstances, gives tabular hexagonal crystals of a yellowish colour and semi-metallic lustre. The variety of aniline blue now used in Judson's sets of dyes also gives a double salt of this kind, and which is very similar to that of rosaniline, only that it has a green tinge. Several others of these bases also form double salts of a like nature; they are characterised by their composition, insolubility in chlorides of potassium or ammonium, and their ready solubility in water and solutions of salts generally, including that of chloride of sodium; indeed, so great is their solubility in these liquids, that it seems they can hardly be formed except by aid of the chlorides first-named. Generally, where the platino-sulphocyanide has been formed, the corresponding platino-chloride has also been formed; these salts are uniformly granular in structure, frequently exhibiting the form of cubes.

The double mercuro-sulphocyanides of these bases are insoluble in bichloride of mercury or water, but soluble in excess of the sulphocyanide; they generally crystallise in a tabular form.

Sulpho-indigotic acid, when warmed with platino-chloride till a clear solution is obtained, gives slender crystalline plates when mixed with sulphocyanide and chloride of potassium; these have greatly the appearance of the corresponding salt of mauveine. By omitting the use of the sulphocyanide, granular blue-coloured crystals were obtained, consisting of indigo, chlorine, and platinum. Both these indigo salts require a long time to form from their solutions, sometimes not commencing this till twenty-four hours after the solution was prepared.

Double mercurial salt of indigo with sulphocyanogen has also been prepared; it is insoluble in water or bichloride of mercury, is of a pale blue colour, and takes the form of tabular-shaped crystals.

Another series of well-defined double salts of these aniline bases is that of the oxalates with those of the alkaline earths; these are generally highly crystalline, and are formed by mixing an ammoniacal solution of the base required with a solution of a salt of the alkaline earth.

Several double phosphates of this kind may also readily be formed. Thus, an ammoniacal solution of mauveine phosphate, mixed with one of magnesia, gives a double

phosphate of these bases in crystalline granules; indeed, many of the acetates of these bases, when rendered alkaline by addition of ammonia, rapidly decompose ammoniacal phosphate of magnesia, producing the kind of salt just described.

Double phosphates of iron, alumina, &c., with several of these aniline bases, can be easily prepared; they are nearly or quite insoluble in water. A very good blue lake can be prepared with ferric oxide in this way. The equivalent of phosphoric acid being very much less than that of tannin (the substance now used along with alumina to fix these aniline colours for pigments), we should expect these pigments, when prepared by the aid of the mineral acid specified above, to be deeper coloured than those in which this vegetable acid enters. For the preparation of this blue pigment, iron appears better than alumina, possibly because its phosphate has a tendency to assume a similar colour to that of the pigment itself; for the same reason, the coloured metallic phosphates, such as those of copper, nickel, and cobalt, appear adapted for the preparation of certain of these coloured pigments.

Many of the insoluble salts of both lead and silver seem to combine with the corresponding ones of some of the aniline bases; for instance, the acetates, sulphocyanides, and oxalates, as also the phosphates. Chloride of silver, and even silver and gold freshly electro-plated and well washed, absorbs mauveine from its solution. This apparent metallic absorption is, however, without doubt a saline one, and indicates the presence of a thin layer of a cyanide or other salt upon the metal; that this is so further appears from the fact that freshly-ignited gold or silver do not absorb this base.

Double sulphides of rosaniline and mauveine with zinc, cadmium, silver, &c., can be formed by administering an ammoniacal solution of any of these bases to one of the metal required, and passing sulphuretted hydrogen into the mixed solution, when the double salt precipitates. They are insoluble in acetic acid.

These results show a great tendency on the part of the salts of the aniline bases to combine with the corresponding ones of the metals, forming double salts of a well-defined character, and which are frequently crystalline. From the known constitution of these bases, we should expect them to imitate in their chemical deportment that of ammonia, but, while the results here described in the main support this view, they obviously show in some respects antagonistic to it. Thus, I am not aware that we have as yet formed double oxalates of lime or baryta with ammonia, nor yet that double neutral acetates of silver or lead with ammonia have been produced. This divergence, however, is not greater than that we are frequently compelled to allow in the case of the corresponding compounds of substances belonging unmistakably to the same class.

No doubt, however, the aniline bases will differ very appreciably among themselves in their behaviour with the salts of the metals, and this accordingly as they are compounded; and it appears a useful work would be that of ascertaining the *amount* and *direction* of this. I have not the leisure as yet to follow this subject up in a proper manner—that is, by ascertaining the precise composition of the compounds here described,—but, as it appears one of some interest, I shall be pleased to learn of anyone taking the matter up.

Laboratory, Wellington, New Zealand,
    April 9, 1874.

NOTES ON THE SODA PROCESS.*
By DAVID HILL.

THE theory of the reaction which takes place in the ball furnace has been a bone of contention amongst chemists for many years, mainly through the fact that a large excess of carbonate of lime has been found necessary to the

A paper read before the Tyne Chemical Society.

successful conduct of the process. It has been established by experiment that sulphate of soda heated with carbon results in sulphide of sodium and carbonic acid; sulphide of sodium presented to carbonate of lime in a heated state results in carbonate of soda and sulphide of calcium. The former reaction has been proved by Liebig, the latter by Kolb. It is a question for enquiry since the balling operation is so simple in character that so large an excess of carbonate of lime and coal are found requisite for its successful conduct.

As the result sought to be attained is the complete conversion of sulphate of soda into sulphide of sodium, and that subsequently into carbonate of soda by means of carbonate of lime, it will require but little reflection to prove that an excess of each constituent required is essential to the attainment of the desired end at each stage of the operation, and when, as in the case of coal, the constituent is liable to be destroyed by burning away through carelessness of the workmen, or otherwise, it cannot be wondered at that a very large excess is required.

The quantity of coal used in practice, is from two to two-and-a-half times that required by theory, even when the value of the coal is estimated from the fixed carbon or coke which it will yield, and some manufacturers prefer a larger excess because of the subsequent advantage in lixiviation; the excess of coal remaining as coke, by keeping the alkali waste free and porous, facilitates and enables the lixiviation to be more complete. The excess of carbonate of lime, on the other hand, which was considered until a very recent date to be essential to the formation of an oxysulphide of calcium, which at one time was considered the only insoluble compound of sulphur and calcium, has had the most light thrown upon it through the working of cylinder furnaces.

It was shown by Gossage that the excess of lime in alkali waste existed mainly as carbonate of lime; this fact of itself was sufficient to explode the oxysulphide theory. Later researches on the compounds of sulphur and calcium have shown that the monosulphide is a very insoluble compound, and it is therefore no longer necessary to assume that the insolubility of alkali waste is due to the excess of carbonate of lime, hitherto requisite for good balls. Finally, Kolb, has shown that sulphate of soda and carbonate of lime in equivalent proportions in presence of an excess of coal, yield carbonate of soda and sulphide of calcium. It thus becomes matter for enquiry, why in the face of these results, a large excess of carbonate of lime is still essential to good balling.

The proportion of lime in good balls stated in equivalents, and compared with the total soda similarly stated, has been found to be from 1·3 to 1·4 to 1,—an excess over the theoretical quantity of 30 to 40 per cent. In the first place, under any circumstances, if we wish a complete decomposition of the sulphide of sodium, we must have an excess of carbonate of lime; in the second place, as the balling is conducted in a rough way, not approaching by any means to laboratory refinement, and as the materials are not intimately mixed before being introduced into the furnace, it may happen through the bed of the furnace being imperfectly cleaned by our too fallible instruments, that one ball may have more carbonate of lime than another, it is necessary to have an excess for all, so as to cover the deficiencies of each ball; thirdly, the variability, where we use chalk in moisture and actual percentage of carbonate of lime, requires a constant excess; lastly, the system of weighing in alkali works, often in careless hands, demands a constant excess of carbonate of lime. In estimating the sum of these necessary excesses at 10 per cent—and there are other excesses peculiar to certain works, which I have not reckoned, there would still remain 20 to 30 per cent of excess to account for. The action of the cylinder furnaces has explained in a very clear way what a considerable proportion of this excess is for. In the first working of revolving furnaces, a very formidable difficulty presented itself: the balls produced were all that could be desired as far as appearances went, and in regard

to the ordinary laboratory testing, but they were found to be almost unacted on in the lixiviating tanks, the carbonate of soda contained in them being to all intents and purposes insoluble; after many trials, Messrs. Stevenson and Williamson patented a method of working the revolving furnaces by which this difficulty was overcome. It consisted in heating the carbonate of lime by itself, or mixed with coal in the cylinder, until a portion was converted into caustic lime, and when this stage was reached, the sulphate of soda was dropped into the cylinder, and the operation finished in the usual way. All cylinders up to this time have been worked in this way, and it has been demonstrated by this necessity, that balls, in order to burst or fall in the tanks, so as to enable the carbonate of soda to be dissolved, must contain a certain proportion of caustic lime. The lime, in slaking, swells and bursts the ball, so that practically the carbonate of soda is thrown in contact with the water in the form of powder. It will be familiar to most persons engaged in the alkali trade how difficult it is to dissolve hard and fluxed lumps of carbonate of soda, and balls produced without lime are practically in this state. To my mind, this action of the cylinders proves conclusively that the mean temperature to which the ball reaches in the cylinder is far short of that reached in the ordinary ball furnace. In fact, in the ordinary furnace, the temperature of working exceeds that at which carbonate of lime is decomposed, while in the cylinder furnace this temperature is hardly reached. If this, then, accounts for a considerable proportion of the excess of carbonate of lime required, we are brought into contact with still another source of excess, and that is the necessarily variable extent of this limeing. It has been conclusively proved, independently of theoretical considerations, that caustic lime will not decompose sulphide of sodium; hence, if in the balling process, whether in the cylinder or hand furnace, the "limeing" be carried too far, balls will be produced, giving a considerable proportion of sulphide of sodium in the liquors, which, if in considerable quantity, will be also apparent in the ball, which will present a "red" or "burnt" appearance, due to undecomposed sulphide.

Briefly, the sum of our knowledge of the balling process is this, that sulphate of soda is reduced by coal to the state of sulphide of sodium, and that this reacts upon carbonate of lime to form carbonate of soda and sulphide of calcium; but in order that the carbonate of soda may be subsequently lixiviated, it is necessary that a certain proportion of caustic lime be present in the ball, and it is highly probable that the excess of infusible lime and coke contributed to the lixiviation in another way, through imparting a stiffness to the balls when drawn from the furnace, so that the gases constantly produced in the balls do not escape freely, and thus cause them to maintain on cooling the honeycombed structure so much desired by manufacturers.

Theoretically we have to deal with pure materials—sulphate of soda, carbonate of lime, and carbon or coal; but all are more or less impure. Sulphate of soda can rarely be obtained of greater strength than 97 per cent, and the average used in the manufacture is probably nearer 96 per cent. It is hardly necessary to observe that the higher the strength of the sulphate of soda the better the yield of carbonate of soda will be, and that, too, attained at the same cost for labour, fuel, and repairs, as for an inferior sulphate. Although the strength of the sulphate may be high, the physical condition of it may be such as to prevent or at least render difficult the process of decomposition in the ball furnace. Premising that the percentage of salt undecomposed is under say 1 per cent, and that the sulphate has been well fired, as manifested by containing only a trace of acid sulphate, and further, that it is free from lime salts (peculiar to sulphate obtained from rock-salt), there should not in ordinary ball furnaces be any difficulty in obtaining that goal of manufacturers, 52 per cent ash; but the sulphate may be as free from salt, well furnaced, and of 97 per cent or upwards of real sulphate,

without being able to turn out from it 52 per cent ash. The chief difficulty in this respect is the physical condition of the sulphate. Carefully prepared sulphate presents the appearance of a spongy mass which can be easily crushed by the pressure of the hand; carelessly prepared sulphate may be hard and lumpy and sometimes entirely fluxed. The two varieties may test exactly the same, but the hard, lumpy, or fluxed sulphate will almost invariably yield inferior results. I am inclined to think that the temperature of fairly worked balls never reaches the temperature necessary to melt sulphate, and that consequently hard or fluxed sulphate is in much the same position relatively in the ball furnace as unlimed cylinder balls would be in the tanks, an imperfect action taking place at the surface, but having very little penetrating power. If also the sulphate has been badly fired, the operation being completed in the ball instead of the decomposed furnace, the escaping acid vapours are partially condensed in the boiling down pans, thus contributing to reduced strength. I think this difficulty, common to practical men, of decomposing hard, or fluxed, or salty sulphate is fully explained by this view. Inferior results are always obtained, and necessarily so, from sulphate prepared from nitre cake, salt cake, or rock-salt; but it is questionable, taking into account the actual percentages of sulphate of soda in the respective sulphates, whether the results are dissimilar.

Limestone and chalk are exceedingly variable in composition, especially chalk, and that particularly in regard to moisture. Siliceous and aluminous deposits in limestone or chalk have the most disastrous effects upon the yield of soda-ash, through the tendency of SiO_2 and Al_2O_3 to form an insoluble double silicate with soda.

Of coals for mixing it may be said generally that the coal which yields a large proportion of coke at the same time that it contains a low percentage of ash, is the most profitable for mixing purposes. It is confirmed by all practical men that certain coals give the best results for mixing purposes, and the approximate analysis of these coals has always shown a high percentage of fixed carbon in coke with a variable quantity of ash; and those coals have generally given the best results which to a high percentage of fixed carbon added a high coking quality. As the greater the coking power of the coal the greater the bulk of the ultimate coke, it will not be difficult to conceive that a smaller quantity of carbon, by presenting an equal or even greater surface, may do an increased amount of work. The mixing coals in general favour contain from 65 to 73 per cent fixed carbon and from 10 to 3 per cent of ash, the remainder being volatile matter and water. The quantity of ash contained in the mixing coal is of vital importance, not only to the strength of ash, but the absolute yield of soda of 48 to 50 per cent, however manufacturers may state their results. The ash of coal consists for the most part of SiO_2 and Al_2O_3, the most pernicious impurities that can be introduced into the soda process, from the fact that they have the power to render an equivalent of soda insoluble, by forming the double silicate of alumina and soda. Some attach great importance to the absence of iron and sulphur from mixing coal, but I am inclined to think that they have very little effect upon the process. As very few practical observations, however, are without the means of explanation, I regard this as simply connected with the large proportion of ash which sulphurous coal invariably gives, and explain the indifferent results observed to the more dangerous constituents of the ash of mixing coal SiO_2 and Al_2O_3.

The condition in which the mixture is supplied to the furnace is of considerable importance. For ordinary furnaces, experience dictates that it should be ground or crushed. The difficulties connected with hard and fluxed sulphate may be to a great extent overcome by crushing or grinding. The quantity of coal required for the balling is considerably affected by the size of the lumps; generally speaking, of two coals, otherwise equal, the smallest coal will do the most execution. The same remark will apply to chalk.

I will not venture to state how good balls should be made, having already said so much on the theory of the process, but pass on to the lixiviation of the balls in the tanks. In the freshly drawn ball from the furnace, it is found that with the exception of 1 to 5 per cent of undecomposed sulphate, in the soluble part, all has been converted into carbonate of soda; in cylinder balls the undecomposed sulphate seldom reaches 1 per cent of the soluble. In fact, it is scarcely possible to get a bad decomposition in cylinder furnaces, while the occasional vagaries of ball-furnacemen, some- times turn out balls with as much as 20 per cent of unde- composed sulphate. However good the balling may be, it may be undone altogether by careless lixiviation. By exposing to an undue temperature, or allowing to stand too long, the tank liquor may become thoroughly impreg- nated with sulphide of sodium and caustic soda. The loss of soda in the shape of reformed sulphate, between the ball-furnace and the tanks, by oxidation, and sulphides formed in the tanks, with good work, I am inclined to think is never less than 3, and more often 4, per cent of sulphate; this quantity, which may be regarded as the unavoidable loss, may very easily be doubled by irregularity in working the tanks. The lime, which contributes to the bursting of the balls, gives rise to the formation of caustic soda, and the quantity formed is in general greater when the liquors are weakest, and it should be an object never to let the liquors get below 50° T. on this account. It is a well known fact, that lime has little or no action on solutions of carbonate of soda of high strength; indeed, a strong solution of caustic soda will partially de- compose carbonate of lime.

One of the most frequent sources of loss in the soda process is that connected with the presence of SiO_2 and Al_2O_3, and I have no doubt that caustic soda is the agent by which this insoluble compound of soda is formed. The presence of caustic soda in tank liquors is for the most part rated an impurity, excepting perhaps by the Lancashire caustic makers. Its presence certainly entails labour and expense to the maker of soda-ash. Besides the caustic soda in tank liquor, there are other impurities which in- dividually require special treatment to remove or destroy them; these are sulphides of sodium, hyposulphide, and sulphite of sodium, a certain portion of the silicate of alumina and soda, held in solution by the caustic soda, and ferro and sulphocyanides of sodium. The only way hitherto used to effect the removal of these impurities is to boil the liquor nearly to dryness, and heat the salts in the carbonating furnace. The waste heat of the ball furnaces, which is universally used to evaporate the liquors, while it economises heat, destroys a portion of the soda; the sulphurous gas passing over the surface of the liquors is partially absorbed, and neutralises its equivalent of carbonate of soda. This loss of soda I have found to be nearly equal to 1 per cent in strength. It has been suggested to boil down the tank liquors by steam, but this has not come into use yet for various causes; one of the advantages of boiling down by steam would be to save the soda, at present neutralised by sulphurous acid.

There have been many attempts made to obtain white alkali direct from tank liquor, and even to utilise the liquor at once for making crystal soda. One of the most trifling impurities in percentage, but most important in its constituents, is the ferrocyanide of sodium, decomposed by heat in the furnace into peroxide of iron, ammonia, and carbonate of soda; the iron communicates to the carbonate a faint yellow colour, and if we removed all the impurities else from the liquor, this residuary iron would still prevent the alkali being used for the finer purposes of the glass- maker.

Up to this time there has only been one successful process for destroying this ferrocyanide in the wet way. Mr. Williamson, of the Jarrow Chemical Co., patented a process for heating tank liquor, for some time and under pressure, at a temperature of 310° F., under which circum- stances the ferrocyanide is completely decomposed. This obstacle being overcome, it is very easy to suggest the

means of getting rid of the other impurities. Treating the tank liquor before or after heating under pressure with carbonic acid, and allowing the separated double silicate of alumina and soda to settle, will yield a liquor capable of making white alkali of good quality. To obtain crystal soda from such liquor, it seems to me only necessary to oxidise the liquor thoroughly, and then con- centrate to the crystallising strength.

I have great faith in the ultimate adoption of some process similar to that just sketched for the manufacture of white alkali and crystal soda direct from tank liquor, instead of the roundabout and costly process at present followed, and I think it probable that a modification of the balling process which I have patented in conjunc- tion with Mr. Black, of Hedworth, will yield a tank liquor of such quality, that some of the obstacles in the way of obtaining white alkali and crystal soda from tank liquor will be to a great extent removed. The large quantity of caustic soda in ordinary tank liquors would require a considerable outlay for carbonic acid to neutralise it, which is absolutely necessary to get rid of the double silicate of alumina and soda, and the presence of a con- siderable quantity of sulphide of sodium would, if crystal soda had to be obtained, entail considerable cost for oxidation. The liquor obtained by this patented process must contain very little caustic soda and less sulphide of sodium than that obtained in the ordinary way.

Although these are advantages which may be reaped it white alkali and crystal soda should come to be made from tank liquor, they are simply incidental to the process, and not by any means its sole aim.

The balling process, even when conducted in revolving furnaces, can only be looked upon as a complicated and uncertain process. Its aim is not simply the conversion of sulphate into carbonate of soda, but the conversion of sulphate of soda into carbonate under such conditions that the resulting carbonate can be dissolved in the present system of lixiviating tanks. Viewing the process in this light we have thought that if the balling process were confined to the manufacture of carbonate of soda, the process would not only be simplified, but that better and more constant results would accrue.

To obtain these results we have thought it essential to dispense with the limeing process in the cylinders and heat the ball mixture so as to avoid as far as possible the formation of caustic lime, and we expect to attain this with less carbonate of lime, and much less fuel for firing than at present, doing, in fact, 25 to 30 per cent more work in the cylinders for the same outlay in fuel and repairs; and by treating the resulting balls by mechanical appliances for the purposes of lixiviation we render the lixiviation independent of temperature, and we expect that the time occupied will be diminished, both circum- stances tending to diminish the quantity of sulphurets in the liquor; and, further, from the balls being practically free from caustic lime, very little caustic soda can be present in the liquors, which will consist of a solution of nearly pure carbonate of soda.

In the conduct of such a modification of the balling pro- cess it seems to me that there are only two points demand- ing careful attention: in the first instance we require to have an exact knowledge of the quantities of the materials in the ball mixture; and in the second instance that the mixture should be thoroughly fluxed before drawing from the cylinder without regard to the consistency of the mass as drawn. At present the working of cylinder furnaces is jealously watched, having regard to four main conditions.

(1). The mixture.
(2). The limeing as judged by observation.
(3). The limeing as judged by subsequent lixiviation in the tanks.
(4). The consistency of the mass as drawn from the cylinder, a condition which is mainly affected, however, by the speed at which the cylinder is driven.

The suitability of the liquor obtained by this process

for the manufacture of white alkali and crystal soda direct, owing to the absence of caustic soda and the diminished quantity of sulphurets, has already been mentioned; the preparation of caustic soda of high strength from it and at less cost is, however, a less speculative aim.

Some alkali manufacturers aim almost exclusively at obtaining a soda-ash of high strength, and in so far as the high strength is obtained by perfect decomposition in the ball furnace, and careful lixiviation in the tanks, it is perfectly legitimate and ought to be the aim of all manufacturers; but it is wiser to strive for a high percentage of soda-ash of 48 to 50 per cent on the sulphate, as by imperfect lixiviation and leakage of red liquor, ash of high strength may be obtained without a satisfactory commercial return. Some practical men look upon a yield of 77 to 78 per cent of 48 on the sulphate, even from cylinder furnaces, with great suspicion; I do not hold this restricted view of the capabilities of the soda process, nor do I think such results necessarily fallacious, and only to be accounted for by the use of excessive weight of sulphate in the ball; still there is such a tendency amongst managers to show good results by giving good weight of sulphate in the balls, and sometimes this is given without the knowledge or connivance of the manager, that we cannot too strongly insist that in instituting a comparison of results the weight of the sulphate used should be accurately known and above suspicion. It is unfortunately only too common a complaint in alkali works, that the stock of sulphate is always found short; I believe that it is no uncommon thing for the weight of sulphate per ball, nominally of 3 cwts., to range from 3 cwts. and 7 lbs. to 3 cwts. and 21 lbs., or 102 to 106 parts of sulphate charged instead of 100. Where such practices obtain the results obtained are apt to render nugatory the importance of knowing the percentage of ash of full strength obtained on the sulphate, as against the percentage of 48 per cent obtained on the sulphate. Careful working has proved that 69 to 70 per cent of ash of full strength may be obtained from the sulphate, and where less than this is obtained it points to imperfect lixiviation and loss by leakage. Where 69 to 70 per cent is obtained, the ultimate yield of 48 per cent depends upon the original strength of the sulphate, the completeness of the decomposition of the sulphate in the ball furnace, and careful lixiviation, which consists in low temperature, rapidity, and not allowing the liquors to get too weak.

PROCEEDINGS OF SOCIETIES.

YORKSHIRE COLLEGE OF SCIENCE.

A MEETING of the General Council of the College was held in the Philosophical Hall on the 17th inst. There were present Dr. Heaton (Chairman), Ald. Barran, Mr. Walker Brooke (Huddersfield), Mr. E. Crossley (Halifax), Mr. F. W. Fison (Burley), Mr. J. R. Ford, Mr. S. C. Lister (Manningham), Mr. F. Lupton, Mr. O. Nussey, Mr. G. H. Nussey, Mr. R. Reynolds, Mr. T. Salt (Saltaire), Mr. T. Scattergood, and Mr. H. H. Sales, Secretary. The Council proceeded to the election of the Professor of Geology and Mining, and the Professor of Physics and Mathematics. The claims of a large number of candidates had received careful consideration at previous meetings. The vote of the Council was unanimously given to Mr. A. H. Green, M.A., late Senior Fellow of Gonville and Caius College, Cambridge, as Professor of Geology; and Mr. A. W. Rücker, M.A., Fellow of Brasenose College, Oxford, as Professor of Physics and Mathematics.

Professor Green graduated at Cambridge in 1855, when he obtained the place of Sixth Wrangler in the Mathematical Tripos, and was shortly afterwards elected a Fellow of his College. In 1861 he was appointed one of the staff of the Geological Survey. A large portion of his time has been spent in colliery districts. He had a share in the survey of the coalfields of Lancashire, North Staffordshire, Leicestershire, and Cumberland. The survey of the Yorkshire coalfield was carried out between 1866 and 1872, partly by himself, and partly by colleagues under his supervision. For the last five years he also held the appointment of Lecturer on Geology at the School of Military Engineering at Chatham. He is a large contributor to geological literature.

Professor Rücker was elected to an open Mathematical Scholarship at Brasenose College, Oxford, in 1867. He gained the Junior University Mathematical Scholarship in 1869, and was placed in the first class both in the first and second public examination for honours in mathematics. He obtained an open Fellowship at Brasenose College in 1871, and was elected to one of the two Mathematical Lectureships in the same College. In October, 1871, he was appointed Demonstrator in the Physical Laboratory of the University, under Professor Clifford. In the latter capacity he has had the sole superintendence of the experimental work performed by the students in the departments of mechanics and heat. He is the author of papers published in the *Proceedings of the Royal Society*.

The appointment of the Professor of Chemistry will be made this day (July 24).

The Council recorded a cordial vote of thanks to Sir A. Fairbairn for his liberal offer of £2000 provided that the sum of £60,000 was placed in the hands of the Treasurer, and resolved upon the necessary steps for raising the required amount.

NOTICES OF BOOKS.

On the Muddy Waters of the Hugli during the Rainy Season with Reference to its Purification and to the Calcutta Water Supply. By D. WALDIE. (From the *Journal of the Asiatic Society of Bengal*, vol. xlii., Pt. II., 1873).

THIS interesting pamphlet contains an account of the construction of the filter-beds at Palta, and of the difficulties experienced in their working. The cause of this, according to the author, must be sought in a peculiarity of the water. Its slowness in clearing, whether of subsidence or filtration, appears remarkable, and is due to the extremely fine state of division of the suspended matter. To its condition the muddy waters of English rivers after an inundation furnish no parallel. The author finds that coarse, gritty sands, such as are commonly used in this country for the construction of filters, are insufficient, whilst the finer kinds are liable to choke. The advocates of coarse sands maintain that filtration depends " on the attractive power of the coarser particles of sand for the finer particles of the mud suspended in the water." Mr. Waldie, on the other hand, holds that " the most important part of the process is straining, the prevention of the passage of particles through narrow crevices between the grains of sand; next is deposition by gravity, on the upper surface of these granules, of still finer particles; and last, and least important of all, is the mutual attraction of particles of mud and sand independent of gravity."

The author refers to the power of certain salts and other soluble bodies of coagulating—if we may use the expression—the clay suspended in water, and determining its precipitation. Certain metallic salts, such as the soluble compounds of alumina, ferric oxide, and copper, possess this property in a marked degree. Alkalies and alkaline earths, and even acids, such as the nitric, hydrochloric, and acetic, exert a similar action. What is more unexpected, neutral salts, earthy and alkaline, have also this coagulating power. Mr. W. Skey, Chemist to the

Geological Survey of New Zealand, in the CHEMICAL NEWS, vol. xvii., p. 160, called attention to the clarifying power of the sodic, calcic, and baric chlorides. The same fact was subsequently (1870) pointed out by Schlœsing in the *Comptes Rendus*. Prof. Jevons " ascribes this coagulation of clay to the water becoming by such addition (of salts) a conductor of electricity, and the clay particles charged with electricity." Mr. Waldie, in connection with this subject, refers to the well-known fact that in washing certain precipitates the filtrate passes clear as long as saline matter is still present, but when this is removed is apt to become turbid. We may here point to the remarkable brilliance of waters naturally rich in soluble salts of lime, and of some even of the most polluted wells. Mr. Waldie finds that the Hugli water during the rainy season contains so little saline matter that suspended impurities are not precipitated. This view is supported by a number of experiments and observations.

The following table shows the approximate quantities of various salts, &c., found to produce an equal effect in clarifying muddy water :—

	Chemical equivalent.	Number of equivalents.	Absolute weight.
Chloride of sodium, or common salt	58·5	40·0	4680
Potassa hydrate	56·0	5·0	560
Soda bicarbonate	84·0	4·0	672
Acetic acid	60·0	3·0	360
Sulphuric acid	49·0	2·0	196
Calcium chloride, or muriate of lime..	55·5	2·0	222
Magnesium chloride, or muriate of magnesia ..	45·5	2·0	182
Nitric acid	63·0	1·5	189
Barium chloride	104·0	1·0	208
Carbonate of lime, dissolved by carbonic acid	50·0	1·0	100
Carbonate of magnesia, dissolved by carbonic acid	42·0	1·0	84
Sulphate of lime	68·0	1·0	136
Sulphate of manganese..	75·5	0·5	75·50
Sulphate of copper.. ..	79·5	0·2	31·80
Protosulphate of iron ..	76·0	0·15	22·80
Protocarbonate of iron, dissolved by carbonic acid	58·0	0·15	17·40
Alum	79·2	0·05	7·92
Aluminum chloride.. ..	44·8	0·05	4·48
Perchloride of iron.. ..	54·7	0·025	2·74

Chloride of potassium or muriate of potassa, sulphate of potassa, acetate of potassa, and phosphate of soda were about equally efficacious with common salt.

The importance of these researches as regards sanitary chemistry—the purification of the water-supply and the treatment of sewage—is obvious.

CORRESPONDENCE.

THE REPORT OF THE ADULTERATION COMMITTEE.

To the Editor of the Chemical News.

SIR,—I have read with the greatest interest your recent articles on the evidence given before the Adulteration Committee, and on the Report supposed to be founded on the evidence.

There can scarcely be two opinions as to the objectionable character of the proposal to make it compulsory on analysts to pass an examination at South Kensington, but we are in a fair way to see this and other absurd recommendations carried into effect, unless, by united action, we do our utmost to express our dissatisfaction.

As a proof of the opposition we have to expect, I may call your attention to the meetings recently held by the wholesale and retail grocers, and to the combined deputation which waited on Mr. Sclater Booth at the Local Government Board on Wednesday last. Among the resolutions passed unanimously at the meeting of wholesale dealers was one which " strongly urged that an appeal be allowed to the Analytical Department at Somerset House before any local convictions be enforced." This means, practically, that the local analysts are to be stultified, and no credence given to their certificates or evidence till endorsed by the chemists at Somerset House. The deputation to Mr. Sclater Booth actually demanded that the sanitary authorities should be instructed not to allow any more prosecutions for adulteration till the Amended Act had been passed.

Among the most objectionable recommendations of the Committee is that an authentic duplicate sample should be sealed by the Inspector and left with the dealer. Analysts have already suffered enough from the substitution of genuine samples for those actually sold, and the effect of such a procedure as that recommended would be to place the Analysts wholly in the power of the Inspectors.

At present, if the Inspector is corruptible, the only harm done by his bribery is that the adulterated sample never reaches the Analyst, and the dishonest dealer is not exposed. But, if the above recommendation became law, the dealer, on learning that the sample had been purchased for analysis, would hold up a bank note and beg the loan of the inspector's seal for a few minutes. Substituting a genuine article for the true duplicate, he would proceed to send the sealed and authenticated packet to one of the gentry known as " dealers' analysts," or even to a respectable chemist of repute, with the certainty of being able to upset the prosecution and seriously injure the reputation of the official Analyst. On this account, Analysts cannot protest too strongly against this fertile source of discrepancy and annoyance.

Fortunately, the Amended Act is not immediately to become law, and chemists will only have themselves to blame if they do not combine, and work vigorously in the interval, to secure a proper appreciation of the ruinous nature of some of the proposals, which seem purposely calculated to drive chemists who have a reputation to lose from the ranks of the Public Analysts.

In the absence of any special organisation for the purpose, I would call the attention of all interested in the matter to two very favourable opportunities which will shortly occur of meeting and discussing the subject in all its bearings, and, if thought desirable, of organising a deputation to the Local Government Board.

One of these opportunities will be afforded by the approaching Pharmaceutical Conference, which will be held in London on August 6th ; the other by the British Association Meeting at Belfast, commencing August 19th.

I believe I am expressing the unanimous feeling of provincial Analysts when I say that we should be very glad to avail ourselves of one or both of the above chances of interchanging thoughts and opinions with each other, and I sincerely hope that those whose position gives them the power of organising the required meetings will not allow two such exceptionally good opportunities of discussing matters of common interest to slip by without an effort being made to obtain what all agree in considering so desirable.

Believing that it is only necessary to call the attention of chemists to the desirability of holding a " conference " to discuss the recommendations of the Committee, in order to have the suggestion carried into effect, I trust you will be able to find space in your columns for this letter.—I am, &c.,

ALFRED H. ALLEN.

Sheffield, July 18, 1874.

THE SOMERSET HOUSE LABORATORY.

To the Editor of the Chemical News.

SIR,—I have read the article in your issue of the 10th, entitled "The Committee on Adulteration." The Somerset House Laboratory has always been eminently distinguished by its unaggressive character, and I am sure I should ill represent it now if I assumed an aggressive tone, or gave utterance to any expression which would tend to provoke discussion.

The Somerset House Laboratory was originally established, in the year 1842, for the purpose of suppressing the adulteration of tobacco and snuff; but, as its usefulness became apparent, its operations were extended, until at length it undertook the detection of adulterations in nearly every commodity subject to duty.

Prior to the year 1842 no special attention had been paid to the detection of adulterations in tobacco or snuff, and consequently methods had to be devised in the Laboratory for identifying the substances which were then extensively used as adulterants. In many cases these adulterants could not be discovered by ordinary chemical means, and the microscope was for the first time employed by me in detecting and identifying, in tobacco and snuff, the presence of foreign vegetable substances from some distinctive features in their structure. By the aid of the microscope, I was thus enabled to detect from time to time such adulterants of tobacco and snuff as peat-moss, starches, malt-combings, ground hard woods, fustic, the leaves and root of chicory, coltsfoot, rhubarb, dock, and other foreign leaves.

A ready and correct method was also devised for detecting and determining in tobacco the presence and amount of saccharine matter when employed as an adulterant. More recently, perfect methods have been successively devised for detecting and separating from tobacco such substances as liquorice, ordinary commercial gums, &c.

At the time the Laboratory was established the adulteration of tobacco was most extensively carried on, but by energetic measures the practice was rapidly suppressed, and the tobacco revenue largely increased. From that time to the present the Laboratory has most successfully prevented the adulteration of tobacco and snuff throughout the United Kingdom, and protected the tobacco revenue, which now amounts to upwards of £7,000,000, at a nominal annual cost.

For years the laboratory most successfully coped with the adulteration of pepper and other articles. The prevention of the adulteration of coffee is, for fiscal purposes, still under the control of the Laboratory, and it is a remarkable as well as a gratifying fact that I have observed no instance in which any analyst has detected any other adulterant in coffee than chicory, and which has now for some years been allowed by the revenue laws to be sold without restraint, either separately or mixed with coffee.

Of late years, the work of the Laboratory has included the examination of lime and lemon juice for the supply of the mercantile marine, the analyses of metals, oils and fats, drysaltery, articles of food, medicines, &c., supplied under Government contracts.

It would be too tedious and encroach too much on your space to enter into a minute account of the various successful investigations that have been made in the Somerset House Laboratory, the results of which have proved, in many cases, of the greatest importance to the state. The investigation which led to devising a method for determining the original gravities of beers and fermented liquids has been productive of great benefit, alike to the brewing and distilling trades and the revenue, and, with the concurrence of these trades, the results were made the basis for legislation.

The results obtained in an investigation of the comparative value of barley, malt, sugar, and molasses for brewing and distilling purposes were also so trustworthy that they were accepted by the trade as a proper basis for legislation.

The devising of the mixture of methylated spirit has been a marvellous success, and few persons should be better able to judge than chemists of the immense advantage that is derived from the use of duty-free alcohol, both in chemical research and also in the arts and manufactures of this country. The mixture was not only suggested by me, but the Somerset House chemists have afforded important aid, by protecting the revenue against abuses of the concession, and thus continuing the use of the mixture for the legitimate purposes for which it was originally intended.

An investigation into the distinctive characters of barley and malt was conducted in the Somerset House Laboratory with complete success, and the results were made the basis of legislation for affording facilities for the exportation of malt, and for preventing the introduction of barley into breweries.

The data upon which the changes in the law were effected for regulating the importation and exportation of tobacco and snuff, and for adjusting the duties according to the proportions of organic and inorganic matter contained in normal tobacco, were obtained in the same Laboratory, and the chemists of that department determine, for drawback of duty, the amount of normal tobacco contained in snuffs and manufactured tobaccos entered for exportation.

A most elaborate series of experiments was made in the same place to obtain the requisite data for extending Sikes's spirit tables, and the result formed the basis for new tables for assaying spirits even up to the strength of absolute alcohol.

Various other investigations have been made, and which I might enumerate, but I think I have stated sufficient to show that the department is not only fairly entitled to respect, but that the work which has been done there since its formation has been both scientific and of the greatest value to the state and the public.

Finally, I may remark that no assistant is put on the Somerset House Laboratory staff unless he has distinguished himself as a student; and I must, in justice, say that the chemical staff of that department stands pre-eminent, both for efficiency and general knowledge.—I am, &c.,

G. PHILLIPS,
Late Principal.

71, Tufnell Park Road, N.

THE ADULTERATION ACT.

To the Editor of the Chemical News.

SIR,—I only express the general opinion of chemists in thanking you for your three admirable articles on the report of the Committee on the Adulteration Act. The proposal to subordinate the public analysts to Somerset House and to South Kensington might indeed have emanated from the office of *Mr. Punch.* Mr. Bell is doubtless a very worthy man, but my knowledge of his existence, and that the Committee proposed to make him act as censor to my work, are of the same date. In reference to South Kensington, I will only remark that, after having convicted its chemist of the discovery of five abortive methods of preparing hydrogen, I should not accept him as an arbiter in any chemical question.—I am, &c.,

J. ALFRED WANKLYN.

Universities Club, Jermyn Street, S.W.,
July 20, 1874.

THE ADULTERATION ACT.

To the Editor of the Chemical News.

SIR,—The subject which you have so earnestly advocated in the last two or three numbers of the CHEMICAL NEWS,

viz., the necessity for an Association of Analytical and Consulting Chemists, is one which every chemist must feel to be of the highest importance. The very proposal of such schemes as the "Somerset House" and "South Kensington" (both of which, by-the-bye, are very unpopular with the majority of chemists) very aptly shows how lightly the dignity of the profession is regarded. It is true several gentlemen, possessing a mere smattering of chemical knowledge, have taken upon themselves the important duties of a public analyst, and have, as would be expected, fallen into errors, and thus cast a stain upon the character of the profession generally. This clearly points the need of association among chemists, so that they may show they do not recognise unqualified persons, which will enable the public to distinguish between those who are chemists and those who, though professing to be, are not. It is to be hoped that the report of the Adulteration Committee will be beneficial in causing chemists to unite for self-protection.—I am, &c.,

W. EDWIN JACK.

DOES SUNSHINE CHECK COMBUSTION ?

To the Editor of the Chemical News.

SIR,—With reference to this subject, brought forward by Mr. Keyworth in the last number of your valuable journal, allow me to suggest that the decomposing influence of the solar rays on carbon dioxide and water being a well-known fact, it seems by no means improbable that these rays would have an appreciable effect in retarding the union of carbon and hydrogen with oxygen, especially in wood, and to a less extent (probably) in coal. Having (in the case of wood especially) just built up the vegetable structure, they would, no doubt, oppose every obstacle to its disorganisation. This seems partly borne out by the fact that the adverse influence of sunshine is considered of more importance when a fire is first lighted, *i.e.*, when paper and wood are the combustible bodies.—I am, &c.,

CHARLES W. FOLKARD.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, June 1, 1874.

Rôle of Middle Section, Polar Surfaces, and Armatures in a Magnet.—M. Jamin.—The author describes experiments which support these three propositions. (1) The number of elementary magnetic threads, and so the quantity of magnetism a magnet may contain, depend only on the middle section. (2) The opening (*epanouissement*) of the poles of these threads, or the distribution of intensities, is regulated by the form and extent of the exterior surfaces of the magnet. (3) If these surfaces diminish, the tension increases till they become insufficient to allow of the elementary poles opening out, and a portion of the two contrary magnetisms disappears, reproducing the neutral state.

Presentation of an Ingot of Alloyed Platinum and Iridium, Cast at the Conservatoire des Arts et Metiers.—Gen. Morin.—The composition was—Iron, 0·006; copper, 0·130; rhodium, 0·060; iridium, 10·370; platinum, 89·044. The mode of preparation is described. M. Deville, in presenting some osmium extracted from the residue of the manufacture of platinum, remarked on the powerfully poisonous character of osmic acid.

Observations on M. Boussingault's Studies with regard to Transformation of Iron into Steel.—M. Chevreul.—An interesting discussion followed this paper, shared in by MM. Boussingault, Dumas, and Pasteur. It referred to the action of hydrogen and carbon in production of steel. M. Pasteur expressed a wish that some of the products obtained by M. Cloëz from action of acids on metals might be submitted to polarised light, comparatively with similar products prepared with the aid of magnetised steel. It appears impossible, he says, to produce dissymmetric organic substances by our laboratory reactions, unless, perhaps, by introducing into these influences of a dissymmetrical order. He makes some striking speculations in this direction.

Researches on the Simultaneous Diffusion of some Salts.—M. Marignac.—Graham, who experimented but little with mixtures of salts, came to the conclusion that, in each case, the diffusibility of the less soluble salt was diminished. M. Marignac finds it is not always so. He has also made many experiments with solutions of two salts not susceptible of reciprocal decomposition in order to deduce their relative coefficients of simultaneous diffusibility; *i.e.*, the relation of the weights of the two salts which are diffused simultaneously when mixed in equal weights, or the proportion of this to that of two mixed salts when the mixture has been made in other proportions. He has not been able to find any general law ruling these phenomena. He makes some general remarks on his experiments, and gives a table in which the acid and basic elements of the salts studied are presented in the order of diffusibility.

Probable Fall of the Flow of Streams in the Valley of the Seine in the Summer and Autumn of 1874.—MM. Belgrand and Lemoin.—They base this prediction on the small amount of rainfall from November 1, 1873, to April 30, 1874. Whatever the meteorological character of the hot season, whether it be very wet or very dry, the hydrological features of the streams are already fixed, and from now till the middle of October the water of the Seine valley will probably sink lower than ever observed before. The authors support this by figures from previous years.

Memoir on the Bay of Saint Jean de Luz.—M. Bouquet de la Grye.—A hydrographic memoir relating to changes produced by the harbour works now in progress.

New Process for Engraving on Copper.—M. Bouquet de la Grye.—It consists—(1) in covering the plate with a thin layer of adherent silver, over which is spread a coloured varnish; (2) drawing the figures, lines, &c., with a dry point (as with the diamond in stone engraving); (3) using perchloride of iron to eat in the traces.

Note on Magnetism (continued).—M. Gaugain.—The author's previous observations have referred to soft iron; he now takes up the case of steel. He magnetised horse-shoe bars by Elias's method, passing bobbins, in which a current was flowing, to and fro together along the branches. A single couple gives better results than a battery of several couples. The magnetisation developed is very different according as an armature is kept applied or not during the operation. It depends also on the number and direction of the passes. A single pass from heel to poles develops a little stronger magnetisation than a pass the opposite way. The maximum magnetisation obtained (with the armature applied, and with twenty or thirty double passes) was nearly quadruple the magnetisation obtained without armature, and with a single pass from the poles to the heel. These are wide limits. The magnetic intensity developed depends, in general, on the initial state of the bar, and it is necessary in many cases to previously demagnetise the bar. The author's former method for soft iron is here applicable. It is long; and there is a quicker process, that of rubbing the horse-shoe bar with a soft iron bar, drawn from the poles to the heel, but the demagnetisation there is incomplete. M. Gaugain analysed the modifications thus produced. Having brought the bar to a minimum state of magnetisation, he traced the curve of demagnetisation. Then he commenced

rubbing in the opposite direction from heel to poles, and traced the curve of demagnetisation. This latter was quite different; it is higher than the first, indicating that the magnetisation is increased throughout the extent of the bar when the friction is directed from heel to poles, and diminished in the opposite case.

Movement of Air in Tubes.—M. Bontemps.—(Fourth note.) Application of Ohm's formulæ continued.

Problem of Mechanics.—M. Durande.—This deals with the case of plane curves, the arcs of which—comprised within suitable limits—are traversed in the same time by a movable body submitted to the action of a certain force.

Principles of Correspondence of the Plane and of Space—M. Zeuthen.

Flattening of the Planet Mars.—M. Amigues.—Geometers, starting with the hypothesis that the matter of the solar system has originally been fluid, have concluded that for every planet resembling a sphere the flattening must be comprised between $\frac{1}{2}\phi$ and $\frac{3}{4}\phi$ (ϕ being the relation of centrifugal force on a body at the equator to the force of attraction). Now Mars forms an exception, the flattening being more than $\frac{3}{4}\phi$. This has been urged as a serious objection to the hypothesis of original fluidity. M. Amigues seeks to remove this objection, considering that geometers have not generalised sufficiently the problem of spheroids. They have all supposed that the density of the layers diminishes continuously from the centre to the surface. Now there is no proof that all the planets have been so conditioned. We can imagine, *e.g.*, a planet cooled and hardened taking a certain form, and afterwards attracting to itself a mass of cosmic matter in its neighbourhood, which would spread over its surface like a torrent of lava. Here the superficial layers might be denser than the central. The author considers the case of a sphere composed of spherical layers, concentric and homogeneous. With regard to Mars he concludes—(1) that it has been formed at two or several different times; (2) that the mean density of the superficial layers is 1·54, that of the nucleus, that is, roughly, of the whole planet.

The Shock of Bodies.—Second note by M. Darboux.

Improvement of Electric Chronographs, and Researches on Electro-Magnets.— M. Deprez.— The author describes how he applies electro-magnets in registering-apparatus for measuring the pressure of powder in guns.

New Triangulation of the Island of Corsica.—M. Perrieu.

Muscular Spectrum.—M. Ranvier.—The observer goes into a dark room, into which light comes through a slit. The muscle preparation (consisting of one or two fibrillæ between two plates of glass) is held before the eye, the longitudinal axis of the primitive bundles being perpendicular to the slit. Two or three spectra then appear, symmetrically disposed on either side of the slit. The author describes also an arrangement in which the muscular spectrum may be used for observing the spectrum of hæmatoglobin. The spectrum is formed only by the transversal striæ, the longitudinal do not produce it. The width and extent of a diffraction spectrum is in relation to the number of striæ. Hence one may, from the spectrum of a muscle, determine the number of "sarcous elements" contained in 1 millimetre of it. The author further studied the changes in the muscular spectrum during contraction. The muscle gives spectra in all the states between complete repose and the most violent contraction.

Condition of Carbon in Cast Iron and Steel.—M. Boussingault.—In reply to M. Chevreul, the author contends that in cast iron, and in certain steels, the carbon is in two states—(1) combined with the iron and therefore invisible; (2) disseminated in the metal, either as an amorphous black powder or in brilliant crystalline laminæ, constituting the graphite of mineralogists. There

is reason to believe that when cast iron is in fusion all the carbon is combined and invisible, but that a portion becomes free on cooling. On acting upon a carburetted iron with acids the state of the carbon is at once made known. The free carbon remains mixed with the insoluble residue. If no graphite is present, but merely combined carbon, there is no carbonaceous residue. The carbon is eliminated during solution, imparting a characteristic fetid odour to the hydrogen gas given off, due to volatile oily matters. This oily matter was noticed by Proust in 1799. M. Chevreul remarked that in this case chemical forces give rise to compounds analogous to those formed by vegetable organisms. More recent researches have established that these compounds are not merely analogous but identical. The author does not believe that a steel exists absolutely free from carbon.

Carbides of Hydrogen Produced by the Action of Acids upon Cast Iron and Steel.—M. Dumas.—When a metal is combined with a non-metallic body, and this compound is submitted to the action of an aqueous acid, the metal seizes the electro-negative element of the acid, or the oxygen of the water, whilst the non-metallic body and the hydrogen unite according to the proportions set at liberty. In the case of a sulphide or polysulphide, we shall have in the first case sulphuretted hydrogen, and in the second a hydride of sulphur. We may, therefore, with some probability, according to the nature of the hydrogen compound formed, characterise the metallic combination from which it is derived. The bodies, whose formation M. Cloëz has established, belong to the series which the author has designated by the symbol C_nH_n. Hence we may conclude that these compounds are derived from a carcide of iron, FeC, which, under the influence of water and an acid, gives $FeO+CH$; the latter, condensing more or less, produces polymers of the series C_nH_n. The mere meeting of carbon and hydrogen in the nascent state, in such circumstances sufficing to produce definite organic compounds, from which all definite bodies of an organic nature may be produced by known procedures of transformation, we are more than ever entitled to confound the chemistry of definite organic compound with mineral chemistry.

Observations on Natural Dissymmetric Forces.—M. Pasteur.—The author wishes that the products obtained by M. Cloëz might be submitted to the action of polarised light comparatively with similar products obtained by the aid of magnetised steel. All mineral products, and all organic bodies obtained artificially in laboratories, are void of molecular dissymmetry, and of the correlative action upon polarised light—properties which are, on the contrary, both inherent in a great number of natural organic bodies, especially such as are physiologically of the greatest importance, such as cellulose, sugars, albumen, fibrin, casein, certain vegetable acids, &c. Ordinary succinic acid, indeed, an inactive body, has yielded in the hands of Messrs. Perkin and Duppa paratartaric acid, re-soluble into dextro- and lævo-tartaric acid, and M. Jungfleisch has subsequently arrived at the same result. Still, hitherto no simple active body has been formed by the aid of inactive bodies. The author is disposed to believe that the number of paratartarics, and of re-soluble paratartarics, is considerable. The paratartarics are one of the forms of bodies which have a symmetrical plan, and they originate under the influence of actions which have nothing dissymmetrical. The opposition between the existence of chemical actions of the symmetric and of the dissymmetric order was introduced into chemical science the day when it was recognised that the physical and chemical properties of dextro- and lævo-tartaric acids, identical whenever inactive, and non-dissymmetric bodies were made to react in their presence, became, on the contrary, unlike when these acids were submitted to the influence of dissymmetric bodies. The part of molecular dissymmetry has been also introduced as a factor in vital phenomena the day when it was established that a living organised

ferment easily caused the dextro-tartaric acid to ferment, but not the lævo-tartaric; and when it was found that living beings derived the carbon necessary for their nutrition from dextro-tartaric in preference to lævo-tartaric acid. Since there is dissymmetry in immediate natural principles, especially in those which may be regarded as the primordial constituents of the living cell; since vegetables produce simple dissymmetric substances to the exclusion of the inverse order; since, contrary to what takes place in our laboratories, the vegetable kingdom does not form exclusively paratartarics or simple inactives, and that probably even these latter products are only formed by secondary oxidising or reducing actions of the same order as those which occur in mineral chemistry, the author concludes that dissymmetric actions preside during life in the elaboration of true immediate natural principles. He thinks that we shall not succeed in breaking down the barrier between the organic and the inorganic until we introduce into our laboratory reactions influences of the dissymmetric order. We should endeavour by all possible means to induce molecular dissymmetry by the manifestations of forces having a dissymetric action. The author suggests the action of magnetism upon bodies in the nascent state.

Falsification of Bees'-Wax with Japan Wax.—Ch. Mène.—Japan wax has been regularly imported into Europe for some years, and is quoted at from 1¾ to 2 frs. per kilo. It is extensively used for the adulteration of bees' wax, the value of which ranges from 3¾ to 4 frs. per kilo. This fraud may be detected by the specific gravity of the sample. That of bees'-wax is 0·96931, that of Japan wax 1·002co. Yet all the mixtures containing from 50 to 90 per cent of Japan wax are lighter than bees'-wax.

Products Formed by the Action of Hydrochloric Acid upon Cast Iron and Steel.—M. S. Cloëz.—The author obtained and analysed a hydrocarbon which distilled between 118° and 124°, and presented the properties of caprylene or octylene, $C_{16}H_{16}$.

Certain Points in the History of Casein and Albumen, with reference to a Recent Note by M. Commaille—A. Béchamp.—The author disputes the results announced by MM. Millon and Commaille, and states that he has anticipated their views on the constitution of the albumenoids.

Discrepancy of Opinion as to the Constitution of the Iron in the Blood.—MM. Paquelin and Joly.—The authors find—That calcination is a defective method for determining the iron in blood. That the results vary according to the duration of the process, and the composition of the matters analysed. That carbonisation in closed vessels, at the lowest possible temperature, is preferable.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, No. 4, May 28, 1874.

Disaggregation of Tin.—A merchant at Rotterdam forwarded a certain quantity of tin to Moscow last winter, in the ordinary form of blocks. The metal was carried by rail during a severe frost, and arrived at its destination in the form of a coarse crystalline powder. Its outward appearance was quite unlike that of tin of good quality. The attempt to re-unite the metal by fusion failed, and gave rise to so large a quantity of stannic oxide, that the whole mass appeared as a grey powder. A sample which fell into the hands of M. Oudemans resembled in appearance molybdic sulphide, rather than tin. The metal was nearly pure, containing only 0·3 per cent of lead and iron. The author thinks that the molecular modification produced in this case was due to vibration and exposure to a low temperature.

"Petites Annales de Chimie."—J. Maumené.—An interesting paper addressed by the author to the Chemical Society of Paris, with the object of inducing that body to enter upon a formal investigation of his theories.

No. 5, June 4, 1874.

This number contains no chemical matter, save what occurs in the *Comptes Rendus*.

No. 6, June 11, 1874.

Destruction of Cockchafers.—M. d'Havrincourt.—The author collected these insects at the price of a franc per 10 litres, and having destroyed them with gas-liquor and sulphuric acid, obtained a good manure. A previous experiment, where the beetles were worked up with lime, gave unsatisfactory results.

Manures for Beet-root.—G. Ville.—The author condemns the isolated use of nitrate of soda and sulphate of ammonia. If used alone they increase, indeed, the yield but deteriorate the quality, and injure the soil. He recommends to avoid the use of animal matters, save in moderate doses, and along with chemical manure. A "complete" chemical manure gives a better crop of beet-root than does farmyard dung. In the formula of such a chemical manure the dose of nitrogen may be brought up to 80 or 85 kilos. per hectare. If dung is to be used along with chemical manures, 20,000 kilos. per hectare should be spread and buried deeply in the soil in autumn. In spring 800 kilos. of chemical manure should be given, and well harrowed in before sowing. Remove all seed plants whose roots are ill-formed, and which show less than 14 per cent of sugar.

No. 7, June 18, 1874.

Bleaching Bones and Ivory.—M. Cloëz.

No. 8, June 25, 1874.

Galenit.—This substance is described as a paint destined to replace both red and white lead. Its source is galena, qualities poor in silver being preferred, but the mode of preparation is not described.

Mineral Manure from Bituminous Schists.—M. Belinet.—A lengthy paper on the agricultural value and method of applying this substance.

Reimann's Farber Zeitung, No. 16, 1874.

This number contains a receipt for dyeing an alkali blue on garments (cotton warps); a continuation of the directions for dyeing and finishing plushes; receipts for printing black, silver-grey, dark brown, and orchil brown on woollen goods; a crimson on alpaca; a green and a magenta on shoddy; a blue pensé and a blonde on alpaca; for aniline blue on cotton yarn, with a base of oxide of tin; for a light mode grey, a reddish mode grey, a light salmon, and a red-brown on woollen yarn; for a blue, a grey, and a claret on wool.

Examination of Glycerin.—Champion and Pellet give the following instructions for testing glycerin:—Dilute with double the weight of water, and mix with acetate of lead. The formation of a deposit is a proof of impurity, which makes the sample useless for various purposes. Oxalate of ammonia should give no precipitate. Absence of colour is no proof of purity. It should be neutral to red litmus and turmeric papers. The presence of glucose—starch sugar—may be detected by adding an alkaline solution of the tartrate of copper, which produces a red precipitate of the suboxide of copper. A genuine glycerin, free from sugar, marks 31·2 of Baumé's hydrometer. If lighter it is diluted with water.

No. 17, 1874.

Rouge de Gravelotte.—This so-called new colour is merely a cochineal red, got up in the usual manner with tin crystals and oxalic acid, and "topped" in a fresh dyebeck with saffranin.

This number contains receipts for a mode grey on woollen yarn; for a pale reseda on the same material; for a Nicholson blue, a dark and a silver drap, a blue lavender, a reseda, and a light olive on wool; a slate grey on alpacas; a pansey, a pale, medium, and dark grey on

calico; a wood brown, two scarlets, a yellow, orange, and light green for woollen printing. None of these receipts offer any decided novelty or advantage.

Adulteration of Orchil.—Arsenical magenta residues are mixed up with farina paste, and used for adulterating orchil paste.

No. 18, 1874.

New Method of Dyeing Ombres. (Yarns dyed in steps with shades of the same colour progressively darker and darker.)—The beck is arranged for the lightest shade, and the yarns are dyed in the ordinary manner. Part of the liquor is then let off, so that its level may read to the point where the next darker shade is to begin. The yarns are lifted, more colour is added to the beck, and the yarns are then returned and dyed, taking care that the portion intended to remain of the lightest shade is not immersed. The same procedure is repeated as many times as gradations of shade are required.

The article on hair-dyes is not adapted for our columns.

There are receipts for dyeing black and light blue on woollen and mixed doubles; for a chamois on wool; for a wood-violet on woollen cloth; a copper and a chrome black on cottons for umbrellas.

Croissant and Bertonnière's Patent.—These inventors make a new class of colours from vegetable and animal refuse of all kinds. The dyes obtained are said to fix themselves upon all kinds of fibre without the use of mordants.

Aniline Black.—Two shades can be obtained, according to Lamy, by passing through chromate of potash, or through soda. By passing through chromate of potash, soaping, washing, and passing through a weak bath of bleaching soda, a violet colour is obtained. By passing through a bath of soda, soaping, and washing, a blue shade is produced. If both swatches are steeped in dilute hydrochloric acid, at 1° Baumé and 18° C., the violet stands better than the blue, which turns green. The question arises whether these two shades are one and the same compound in different degrees of oxidation, and if the black itself is not a combination of superimposed layers of these two shades. Lamy treated pieces printed with aniline black, and taken from the dyeing-house after various terms of exposure, with chromate of potash and with soda, and obtained a number of violet and blue shades. Swatches from a fully aged piece showed, after passing through chromate, a violet-black, and if treated with soda a blue-black.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

An improved process of and apparatus for manufacturing caustic soda. Louis Bois, fils, chemist, Lyon. October 23, 1873.—No. 3452. Steam is made to pass through a series of pipes containing red-hot scrap-iron, and is thereby decomposed, the oxygen being conducted into pipes of refractory material containing carbonate of soda, which, seizing or absorbing the oxygen, is converted into caustic soda. The hydrogen of the steam is expelled by suitable means.

Improved evaporating or recovering furnace or apparatus to be used for evaporating the water in soda-lye, or liquids containing any valuable sediment or body, so that the same may be rendered fit for being again used for manufacturing purposes. Charles Stevenson, Milngavie, Stirling, N.B. October 25, 1873.—No. 3474. This invention relates to distributing the soda-lye or liquid to the action of the fire, and that by means of perforated trays, slits, rose-pipes, or whatever may best distribute or break up the said liquid into rain-drops or spray; same to be placed in position as found necessary, the soda-lye being allowed to percolate the said trays, or slits, or pipes, by its own gravity. And also forcing the liquid through said perforations by means of a force-pump, reserving the right to force in longitudinally by force-pump a spray of soda-lye or liquid over the flame, all for the purpose of breaking up the liquid and exposing it to the full action of the flame. Likewise this invention relates to the use of agitators in the furnace for the purpose of stirring up the sediment or ash which will fall from the evaporated lye or liquid, so as to expose more fully any moisture which may still remain in the sediment whatever it may be, and, at the same time, serving the purpose of a scraper in drawing orward to a bench formed in the furnace the recovered ash or sediment.

An improved method of obtaining a black pigment for paint by the utilisation of a chemical by-product or refuse, and for the machinery or apparatus connected therewith. Robert Owen, Bowdon, Chester. October 28, 1873.—No. 3502. The by-product or refuse for manufacturing the black pigment is the residue arising from the manufacture of prussiate of potash, the residue being commonly called animal charcoal or carbon by the manufacturers. This residue contains ashes or gritty matters enveloping or mixed among the fine particles of carbon or charcoal, and the object of this invention is to separate these coarse and fine matters in the most efficient and economical manner, for the purpose of enabling the finer particles to be combined into a black pigment, or used as a powder, which, when worked up with boiled linseed oil and other matters used by painters, produces a cheap and durable black paint; but bluish shades can be obtained by an admixture of any of the drugs used by dyers for the purpose of having blue tints, and for the purposes of separation and grinding there are tanks, a separating- or dividing-trough, a filtering-trough, and for grinding the blocks a conical grinding-mill.

Improvements in the process of, and kilns for, burning lime, bricks, tiles, and other articles, and for the calcination of minerals. Major-General Henry Young Darracott Scott, C.B., Ealing, Middlesex. October 28, 1873.—No. 3505. The object of this invention is the economy of fuel in lime- and brick-burning, and other analogous processes, and in the roasting of ores, such as iron ores. This object is accomplished by combining the principle of the ordinary running lime-kiln or ordinary brick-clamp, in which the mineral and fuel are interstratified, with the flare principle of burning, the flare being produced by the gaseous fuel of coal, and the coke which results after the gases are expelled from the coal being employed for the layers of fuel, which are mixed with the mineral or article to be operated upon.

Improvements in the construction of thermo-electric batteries or piles, and in the application of the electric currents derived therefrom through the medium of a novel arrangement of electro-magnets. Camille Alphonse Faure, Trafalgar Square, Charing Cross, Middlesex. October 30, 1873.—No. 3540. The novelty of the invention consists in arranging two plates or cylinders in such a manner that there will be an opening or annular space formed between them, which is filled with sulphuret of lead or "galena;" one of the plates or cylinders is kept hot by artificial means, and the other kept cool by the application of water. The two plates or cylinders form the poles of the thermo-pile, which are connected together by a suitable conductor, and which receives the electro current passing through the "galena," and transmits it to a magnet, around the cores of which a number of separate isolated strands of wire are wound, each strand being separately connected with the poles of the battery or thermopile, thereby producing electro-magnetic power, which actuating an armature through a series of "break" and "make" currents, a revolving motion to a shaft is given which may be employed for driving purposes.

Improvements in apparatus for utilising sewage. John Flewitt Milnes, Park Valley, Nottingham. October 31, 1873.—No. 3541. The improvement consists in constructing a series of pits along the sewer bottom. The top of each pit is provided with a grating, each succeeding grate being a finer guage than the preceding one; over each pit the crown of the sewer has an orifice, through which is passed a tube, the bottom of which fits and rests upon the kerb of the pit, while the top conforms to the shape of the orifice in the crown of the sewer, so as to prevent the escape of gases. The solid sewage deposited in the pit is emptied through the tube by means of buckets, Archimedean screws, or equivalent contrivance.

Improvements in removing sulphur from caustic soda or ammonia when containing sulphides. Ernest Smith, manufacturing chemist, Glasgow. November 3, 1873.—No. 3573. In the case of soda, the liquor has suspended in it granulated zinc, with which it is agitated until all the sulphur has combined with zinc. The zinc that is unacted on is then removed, and the zinc sulphide settles to the bottom. In the case of ammonia, the same process is adopted, or a solution of ammoniacal salt may be put in a still with the lime necessary for rendering the ammonia caustic, and with a quantity of ferrous sulphate, whereupon the caustic ammonia may be directly distilled over free from sulphur.

Improvements in obtaining colouring matters and other substances from certain waste materials resulting from the manufacture of gas. John Rowley, manufacturing chemist, Camberwell, Surrey. November 4, 1873.—No. 3588. This invention relates to the production of blue and other colouring matters, and other substances, from certain waste materials obtained from the purifiers employed in the manufacture of gas.

Improvements in the manufacture of soaps applicable for use as lubricants and for other purposes. Edouard George Peter Thomas, Star Chemical Works, Brentford, Middlesex. (A communication from Jules Persoz, chemist, Rue des Ecoles, Paris). Nov. 5, 1873.—No. 3603. This Provisional Specification describes dissolving oils or fatty bodies in a heavy oil, and forming soap in the midst of the liquid mass by the addition of alkali. Sodic and potassic soap are made with a light oil instead of a heavy oil. The light oil is removed by distillation.

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THE REPORT OF THE ADULTERATION COMMITTEE.

IT appears after all that the Inland Revenue chemists seriously think themselves entitled and qualified to revise the work of the public analysts, and feel aggrieved that their claims are not accepted by the profession. Had we gone out of our way to make a gratuitous attack upon them, the letter of Mr. G. Phillips would have been highly pertinent. But, as the question stands, his statements, in as far as they are relevant, decidedly support the view we have taken. The specialities of the Excise chemists, as we were quite aware, are tobacco, snuff, and alcoholic liquors. But Mr. Phillips produces no evidence that, as regards milk, butter, flour, and bread—the articles which most frequently give rise to prosecutions,—their experience and their ability are superior, or even equal to, those of many of the public analysts. His letter goes not one jot or tittle towards proving that they are qualified to sit in final appeal upon the results obtained by men of European celebrity. The referees, whoever they may be, will have to decide on not merely the guilt or innocence of an accused tradesman, but the professional competence of two chemists, and frequently the trustworthiness of analytical processes. We may of course be mistaken, but we submit that such duties should be entrusted not to a chief and his staff of assistants—not to a body of friends or colleagues—not, above all, to Government officials,—but to two or more well-known chemists, independent of "Departments" and of each other. In this manner the prejudices, the partialities, the interests, the whims, and the methods of each will be counterbalanced by those of the rest, and a fair result may be reasonably expected. It is significant that not an unbiassed voice has been raised in opposition to our views. Not one public analyst has expressed his willingness to accept the Excise chemists as final referees.

ON THE
ABSORPTION OF ROSANILINE, MAUVEINE, &c., BY SILICEOUS SUBSTANCES GENERALLY.

By WILLIAM SKEY.

In the second volume of the *Transactions of the New Zealand Institute* I showed that silica, even in the anhydrous form, is a "mordant" of sufficient power to enable it to absorb certain organic substances from solution in weak acids; and in continuation of this subject I have tested this mineral, as well as many others, in respect to their deportment with the aniline bases; and the results of this investigation exhibit a remarkable tendency, on the part of these bases, to attach to siliceous matters generally, as well to several other substances of a widely different nature.

Since these results have been obtained, however, I find Dr. Reimann has anticipated me in reference to silica as chemically prepared; this gentleman having shown[*] that silica in this state rapidly absorbs the aniline bases generally from their acetic acid solutions, and playing the part, as he supposes, of a mordant.

It is, therefore, proper to notice this circumstance first, having done which I now proceed with my subject; and I cannot, perhaps, do better than take it up at the point Dr. Reimann has left it, and that at which we are now at.

[*] CHEMICAL NEWS, vol. xxii., p. 83.

Starting, then, with the announcement of the behaviour of silica with these bases. I understand, from the brief notice of Dr. Reimann's observations alluded to, that in the case of compound silicate, like glass, it is supposed that their silica "must first be made active," in order that they may "take the dyes," and, further, that free silica in a certain condition only, such as that in which the chemically prepared substance is in, will absorb these dyes; but my experiments show, on the contrary, that glass and silicate generally freely absorb many of these dyes when unprepared, and further, in the case of silica, no such limitations occur as the ones inferred.

My results show that pure quartz readily absorbs mauveine and rosaniline, as well as many other of these bases, from their acetates; a portion of the acetic present is also absorbed. Hydrous, as also anhydrous, silicate of alumina readily absorbs these bases partly or wholly as acetates, when a large quantity of these bases is used relatively to that of the siliceous mineral; a portion is removed by pure water or by alcohol.

The single silicates of magnesia or lime display great absorptive power for the bases named, and do not give them up to water; these behave similarly with the blue dyes. Some of these bases are only absorbed readily by these silicates when a certain quantity of saline matter is present in solution. The blue dye of Judson's "Hofmann's blue," I believe, is of this kind, and this deportment of it is well exhibited in the case of clay; thus, when this dye is mixed with clay in certain proportions, a clear colourless liquid and a rich blue sediment are obtained, but when this sediment is thrown on a filter and washed with pure water, the filtrate gradually becomes turbid and coloured, and by continuing the washing the whole of the colouring matter passes through the filter. If now a little of a neutral salt is dissolved in the filtrate, the clay and colouring matter precipitates simultaneously. A silico-acetate of the organic base, with alumina, appears to form in this instance.

The felspars, especially those of potash and soda, do not so readily absorb these bases as the silicates just mentioned.

The carbonates and sulphates of lime, baryta, &c., exercise no absorptive action on the bases named.

Besides these siliceous substances, I find resins and fats generally absorb these bases, as also paraffin. Stearic acid warmed with any of them takes up the base to form a soap of a rich colour, and which is insoluble in water, but soluble in alcohol, and is entirely precipitated from its alcoholic solution by water.

A number of the metallic oxides and sulphides also absorb these bases from their solution in acetic acid; oxides of zinc and mercury, for instance, and the recently precipitated sulphide of these metals, the pure native sulphides also, have a feeble absorbent power for these bases. In all cases, it seems the absorption is wholly a chemical one.

The results described show a great chemical activity at common temperatures on the part of a group of the most insoluble and apparently inert of our native minerals.

The fact that certain clays, or clays generally, absorb ammonia, potash, &c., from their solutions, has been long since made known by Professor Way, but, from the similarity between these bases and those of the aniline series, and the facts here described, it appears that ammonia and the fixed bases are superficially absorbed by most siliceous substances—by quartz and simple earthy silicates in particular, but by the felspars only feebly, at least when freshly exposed.

In the case of anhydrous minerals exercising absorptive functions, we may, I think, properly suppose that they hydrate previously to this; the tendency of siliceous minerals of such a nature to pass to this condition in presence of water having been already shown by me in this periodical.

The absorption described being undoubtedly a chemical one, we possess in these aniline dyes agents which, by

their great calorific power, manifest palpably and rapidly the amenability of some of the most apparently inert native minerals unto chemical influences.

The effect of saline matters in enabling clay to retain certain of these aniline bases is suggestive of the necessity of having our soils charged with weak saline solutions in place of pure water, in order that their absorptive power for certain substances may be exercised ; and it also suggests the idea that such solutions, if saline, if beyond a certain degree, may retard vegetable growth, by attaching the necessary food for this unto the soil in too insoluble a form.

Laboratory, Wellington, New Zealand,
April 9, 1874.

CORROSION OF TIN AND TIN-LINED WATER-PIPES.*

WE have been much interested in reading the article of Professor S. P. Sharples in the July issue of the *Journal*,† and are moved thereby to give briefly some of the results of our own practical experience, extending over more than twenty-five years, regarding the action of water on lead and tin pipes.

We have during this time put into and taken out from wells, springs, and aqueducts thousands of feet of tin and tin-lined pipes, and in no instance within our recollection, where we have seen the interior surface of any of these pipes after a year's use, have we failed to discover more or less corrosion.

Spring- and well-water seem to act upon the tin quicker than pond- or river-water.

Hundreds of feet of block-tin pipe which we have put into wells we have been called upon to replace with new after ten or twelve years' use, the old pipes being so corroded as to be useless. Portions of some of them we have found to be so completely oxidised as to crumble at the touch, while other portions of the same pipe would be comparatively smooth and free from any corrosion.

Called upon a few days since to make some repairs upon an ordinary house-pump, we had occasion, in taking it down, to cut off the pipe leading to the well, and an examination of this showed it to be tin-lined lead pipe considerably corroded, the tin being completely eaten through, in many places of the size of small shot. Pursuing the investigation still further, we found a short piece of lead pipe (unlined), connected between the tin-lined pipe and the pump, which was perfectly smooth and free from the action of water. The solder joining the two, a mixture of probably nearly equal parts of lead and tin, was also bright and smooth.

The facts ascertained upon inquiry were these :—

Twelve years ago the pump was put in with lead pipe leading to well, and after a lapse of eight years the lead pipe was replaced by the tin-lined, with the exception of the short piece before mentioned, which for some reason was left untouched. Here, then, we have tin and lead under precisely the same conditions of exposure, the former practically useless after four years' use, while the latter was absolutely perfect and uninjured after twelve years' contact with water.

This case, as regards the durability of the lead, we should call exceptional, as most pipes of that metal, exposed to the same test, would show the action of the water in ten or twelve years.

We never had any reason for supposing that the tin furnished by any manufacturer was anything but commercially pure tin, but it is well known among plumbers that occasionally a pig of tin is found, which will not make good plumbers' solder by reason of the natural impurities contained in it ; and our theory of the matter is,

* From an advance sheet of the *Boston Journal of Chemistry.*
Communicated by the Editor.
† See CHEMICAL NEWS, vol. xxx., p. 6

that it is these natural impurities existing in both lead and tin pipes which are corroded away by the water from the purer surrounding portions. In no other way can we account for the smooth and sound appearance often found in the same pipe in close proximity to badly corroded portions.

<div align="right">A. M. KNIGHT AND SON.</div>

Springfield, July, 1874.

TECHNO-CHEMICAL GAS ANALYSIS.
By CLEMENS WINKLER.

AFTER a lengthy dissertation on the importance of a simple and practicable system of volumetric gas analysis, the author proceeds to describe the apparatus required. It consists of a two-limbed tube, Fig. 1, one limb of which, A, can be closed air-tight by two slightly-greased glass taps, *a* and *b*. This shut-off portion of the tube contains about 100 c.c., and it is once for all carefully measured, and the amount inscribed upon the glass. This tube, which we may call the measuring-tube, is graduated from tap to tap into cubic centimetres and decimal parts thereof, the divisions being carried out on the narrower parts of the tube close to the taps. The measuring-tube serves for the reception of the gas in question, and is filled with it by opening both taps, and drawing the gas through by means of an aspirator, until it is certain that all atmospheric air is expelled. The tap communicating with the aspirator is then first closed, and afterwards the one through which the gas enters. If the filling of the tube is not effected by means of an aspirator, but by connection with an apparatus in which the gas is generated, or with a gasometer, or under the pressure of a column of liquid, the outlet-tap of the measuring-tube is likewise closed first, and the entrance-tap last. The extra pressure is then got rid of by momentarily opening one of the taps, and the gas is thus brought in equilibrium with the external air. We have also to be satisfied that the gas to be examined is saturated with watery vapour ; this is effected by allowing it, before entering the measuring-tube, to pass through wet cotton-wool, which serves also to remove mechanical impurities, such as soot, flue-dust, &c.

When the tube A has been filled, with the above-mentioned precautions, the next step is the determination of the several gaseous constituents by an absorptio-metric process. The limb B serves for the reception of the absorbing liquid ; it is selected wider or narrower as the case requires, and it is connected with the limb A by means of a piece of caoutchouc tubing. On pouring the absorbing liquid into the tube B, there is formed under the tap *a*, affixed to the measuring-tube, a collection of air, which must first be removed. For this purpose the tap is provided with two perforations ; the one is the ordinary transverse aperture, and serves to place both limbs of the tube in connection ; the other goes in the direction of the tap-handle, which terminates in a pointed tube, which again can be closed by means of a piece of caoutchouc tube and a pinch-cock. In this manner it is practicable to let out the included air through the longitudinal aperture of the tap *a*, and, when this has taken place, to prevent the liquid from escaping by means of the pinch-cock. This construction of the tap also enables the measuring-tube to be placed in direct communication with the external air. The different positions which may be given to the tap *a* are seen in Fig. 2. Position *a* connects both limbs of the tube, position *b* connects B with the external air, and position *c* places the latter in connection with the measuring-tube A. After filling the measuring-tube with the gaseous mixture, the tap *a* was in the position *b*, and a cautious opening of the pinch-cock released the enclosed air through the liquid in B. The gas and the liquid are now only separated by the tap *a* ; by turning this round 90°, it takes the position *a*, Fig. 2. A communication between both limbs is thus

effected, and absorption begins, aided by the pressure of the column of liquid. To expedite it, however, the support bearing the tubes is so arranged that they can be alternately placed either horizontally or vertically. Before being placed in a horizontal position, the tap *a* is placed in the position *b*, Fig. 2, and a tube, *e*, bent at right angles, is connected with the limb B, in order to prevent the escape of the liquid when the tube is inclined. In the horizontal position of the tubes the absorption is very active, as may be perceived if the tube is replaced in the vertical position, and the tap *a* is re-opened ; immediately a fresh quantity of liquid forces its way into the measuring-tube. This alternating inclination of the tubes, the tap *a* being closed each time, is continued until no further entrance of the liquid into the measuring-tube can be perceived,—a result which is mostly effected in a few minutes.

FIG. I.
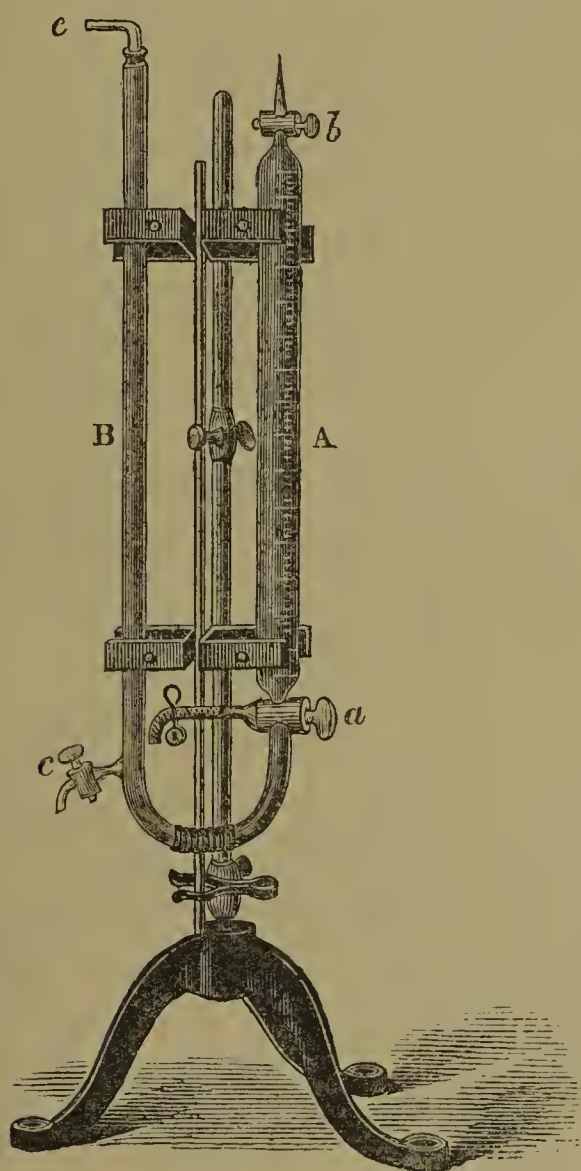
It is now necessary to bring the liquid in the two connected tubes to the same level, which is effected by the exit-tap, *c*, Fig. 1. The volume of liquid which has entered into A represents the number of c.c. of absorbed gas, and when it is multiplied by 100, and divided by the total capacity of the measuring-tube, the percentage of the absorbed constituent is found.

From the above it appears that only one gaseous constituent, or the sum of several can be determined at once. If a complete analysis is required, as many apparatus can be used at once as there are gaseous constituents to be determined. The measuring-tubes are connected together with caoutchouc tubes, and filled at once. The analyst has thus the advantage of operating upon a set of portions filled under the same conditions of temperature and atmospheric pressure, and equally saturated with watery vapour, so that the customary corrections for temperature may be dispensed with. The determinations take so little time that an alteration of the volume of the gas from a change of temperature is not to be feared. Care must be taken that the various absorption liquids have all the same

temperature. To regulate the temperature of the gaseous mixture, it is allowed to pass through a bottle of mercury, which is kept along with the absorbents. If it is required to determine relatively small amounts of a gaseous constituent, a somewhat modified construction of the measuring-tube is needful. The lower part nearest to the tap *a* is made narrower, so as to admit a more accurate graduation, say in $\frac{1}{20}$ths of a c.c. In this case the graduation of the tube need not be continued for the whole length of the tube.

The description of the method by which the author secured gaseous mixtures of known composition, in order to test his method, is omitted as unnecessary, and we pass on to the determination of individual gases.

1. *Watery Vapour.*—It has been already observed that all gases are saturated with watery vapour prior to

FIG. 2.
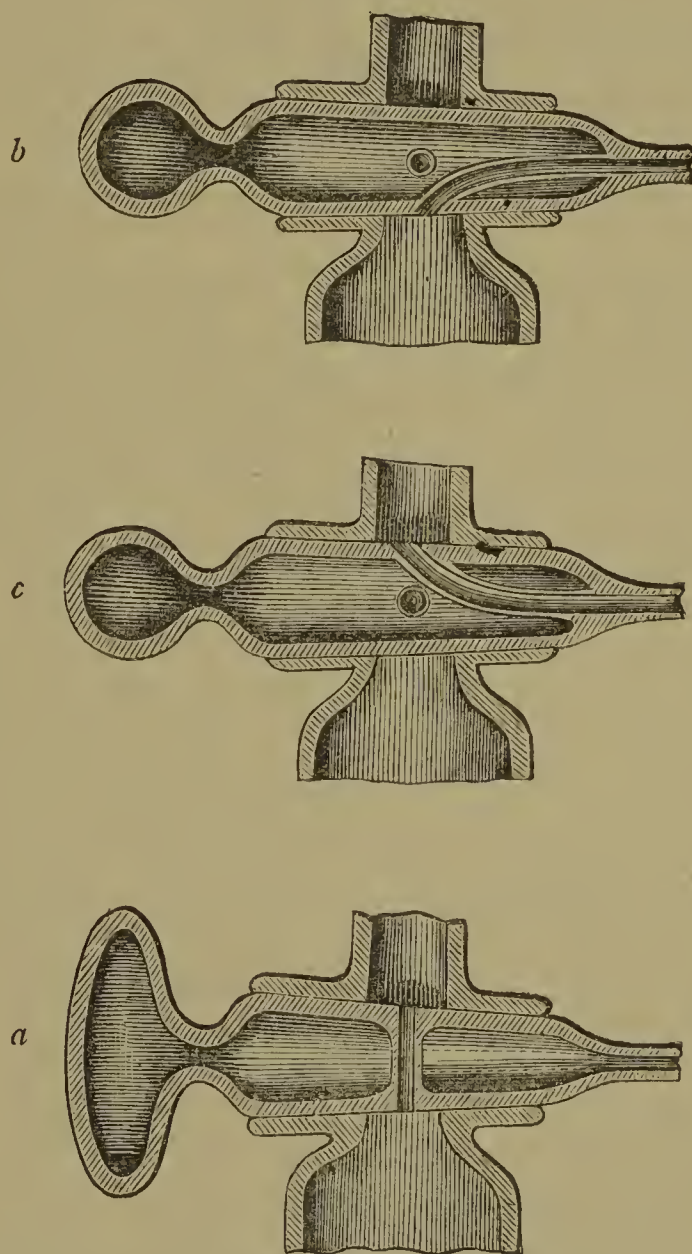
measurement. The determination of the water present is not necessary in every case. If it is required to find the amount of watery vapour in a gaseous mixture concentrated sulphuric acid is used as absorbent liquid. By inclining the tubes a few times, the gas is dried completely. Before reading off, the sulphuric acid is allowed to stand for a few minutes.

If the gas under examination contains originally a certain amount of water, without being saturated, two determinations are required. One apparatus is filled direct with the gaseous mixture, without allowing it to pass through the tube filled with wet cotton-wool; whilst another is filled with gas which has been thus saturated. The difference which appears between the two subsequent measurements with sulphuric acid corresponds to the volume of watery vapour which the gas took up in passing through the damp cotton.

108·7 c.c. air, treated direct with sulphuric acid, required 0·9 c.c.=0·82 volume-percentage of water.

106·8 c.c. air, saturated with watery vapour, required 3·3 c.c. sulphuric acid = 3·11 volume-percentages of water.

The water taken up for saturation amounted, therefore, to $2 \cdot 11 - 0 \cdot 82 = 1 \cdot 29$ volume-percentages.

The determination of oxygen in the air saturated with watery vapour yielded 20·44 per cent; consequently, the original unsaturated gas—

$$100 - 2 \cdot 11 : 100 - 0 \cdot 82 = 20 \cdot 44 : x \; ;$$

$x = 20 \cdot 70$ per cent (measure) oxygen.

Hence it follows that the air in question contained—

Oxygen .. .. 20·70
Nitrogen .. .. .. 78·48
Watery vapour .. .. 0·82

2. *Carbonic Acid.*—The determination of carbonic acid is not only very rapid, but yields results which, in point of accuracy, leave nothing to be desired. A moderately-concentrated solution of the hydrate of potassa is used as absorbent.

3. *Nitrogen.*—The direct determination of nitrogen has not hitherto been found possible. It is estimated from the difference, and, as a matter of course, the residue, representing nitrogen, is burdened with every error in the whole analysis.

4. *Sulphurous Acid.*—The method employed for carbonic acid can be used in many cases where it is needful to ascertain the amount of sulphurous acid present in a gaseous mixture. The absence of carbonic acid and of other gases soluble in alkaline solutions must, of course, be ascertained with certainty, otherwise the result would be found too high. For certain furnace gases produced without the use of fuel, *e.g.*, by roasting pyrites in kilns, the potash process is directly applicable, since the error occasioned by the trace of carbonic acid present in the air supporting the combustion is too trifling to be appreciated.

If, in a gaseous mixture under examination, other gases absorbable by potassa-lye are present in addition to sulphurous acid, a solution of iodine in iodide of potassium is used as absorbent, of the strength of the deci-normal solution used in volumetric analysis. It must be remembered that this liquid is also not quite without action upon carbonic acid, which it dissolves mechanically to some extent, as does water. This difficulty was got over by using a solution through which a current of carbonic acid had been passed for some hours. When the iodine solution penetrates into the measuring tube, it is immediately decolourised, and it is only after repeated inclinations that an excess of iodine becomes perceptible within the tube. This excess must be present if the determination is to be correct. If the liquid remains colourless, it is a sign that the solution of iodine employed is not sufficiently concentrated, and that, in consequence, a part of the sulphurous acid is not oxidised, but mechanically dissolved.

The volumetric determination of oxygen in gaseous mixtures is effected by means of a solution of pyrogallic acid in potassa-lye. The liquid is prepared specially for each determination by dissolving 1 to 2 grms. of pyrogallic acid in a little water, and adding about 100 c.c. of a tolerably concentrated potassa-lye. The absorption is rapid at first, but becomes slow towards the end. Hence it is prudent, after the action is apparently over, to leave the liquid still for some minutes in contact with the gas, turning the tubes occasionally. Before reading off, it is necessary to wait till the brown froth has subsided. A determination requires about ten minutes.

If, in a mixture containing oxygen, gases are present which are absorbable by alkaline liquids, such gases are naturally absorbed by the pyrogallate of potash. This is, *e.g.*, the case if carbonic acid is present. Under such circumstances, the carbonic acid present is determined separately in one apparatus by absorption with potassa-lye, and in a second the joint amount of oxygen and carbonic acid is absorbed by pyrogallate of potassa, and the net volume of oxygen is then found by subtraction. If, in addition to oxygen, nitrogen, and carbonic acid, sulphurous acid be also present, we determine—

By pyrogallate of potassa, $O + CO_2 + SO_2$
By potassa-lye, $CO_2 + SO_2$
By iodine solution, SO_2

The residue is nitrogen.

6. *Nitric Oxide and Nitrous Acid.*—The volumetric determination of the lower oxides of nitrogen is a matter of so great importance that the author proposes returning to it when he has a more extended experience at command. In the meantime he considers that a saturated solution of green vitriol seems to have a sufficient absorptive power for the volumetric determination of nitric oxide, though the numbers obtained are not, so far, as constant as might be desired. The absorption of nitrous acid can be effected by means of concentrated sulphuric acid. Whilst, however, we may assume with tolerable certainty that nitrous acid may be absorbed by means of sulphuric acid in gaseous mixtures containing nitric oxide, it is questionable whether, conversely, nitric oxide can be determined by green vitriol in presence of nitrous acid. It appears that green vitriol absorbs nitrous acid also in not inconsiderable amount, whether by simple solution or by some chemical change being not yet decided. If this is confirmed, then in all cases where the two gases are jointly present it will be requisite to determine the nitrous acid direct in one apparatus by sulphuric acid, whilst the nitrous acid must be withdrawn from the gaseous mixture, as a preliminary to the determination of the nitric oxide by green vitriol in a second apparatus. This would be effected by passing the mixed gases through a washing-bottle filled with sulphuric acid, previous to their admission into the measuring-tube.

7. *Chlorine.*—The determination of chlorine can be effected in most cases by means of a moderately-concentrated solution of the hydrate of potassa. The process is rapid, and can be recommended when no other gas capable of absorption by alkalies is present along with the chlorine. An admixture of such gases, especially of carbonic acid, is found when chlorine gas is evolved from a calciferous manganese. In such cases the chlorine must be absorbed by a liquid which has no action upon carbonic acid. A solution of protochloride of iron, mixed with hydrochloric acid, answers the purpose satisfactorily; it must, however, be previously saturated with carbonic acid, by passing that gas slowly through it for some hours.

8. *Hydrochloric Acid.*—Potassa-lye is employed with satisfactory results. If carbonic acid is simultaneously present, hydrochloric acid gas might possibly be absorbed by water previously saturated with carbonic acid.

9. *Ammonia.*—The absorption of ammonia is most readily effected by means of dilute sulphuric acid.

10. *Sulphuretted Hydrogen.*—A solution of hydrate of potassa absorbs this gas rapidly and completely. If carbonic acid is simultaneously present, the case is not free from difficulties. The author passes the gaseous mixture through a washing-bottle filled with a concentrated solution of iodine previously saturated with carbonic acid; in this the sulphuretted hydrogen is oxidised, and the sulphur deposited. The remaining gases, including the carbonic acid, pass on into the measuring-tube. The carbonic acid is then determined in one apparatus, in the portion of gas thus freed from sulphuretted hydrogen, by means of potassa-lye. A second apparatus is filled with the gas in its original condition and carbonic acid *plus* sulphuretted hydrogen. It may here be remarked that sulphuretted hydrogen is advantageously collected over petroleum, by which it is not at all absorbed.

11. *Carbonic Oxide.*—The discovery of a simple and accurate method of determining carbonic oxide in a gaseous mixture is of the utmost importance for the right management of combustion under a variety of circumstances. The absorbent used is a solution of cuprous chloride in hydrochloric acid. The chloride for this purpose was obtained by precipitating cupric chloride with stannous chloride. The white crystalline precipitate is first repeatedly washed with cold water by decantation, then twice washed with strong alcohol, and finally, once

with ether. It is then dried at 80° to 90° C. in a current of carbonic acid. The white salt is preserved in air-tight bottles. It is easily and plentifully dissolved in hydrochloric acid, and if a spiral of copper wire is kept in the liquid reaching from the bottom to the neck of the bottle, and if the latter is kept carefully stoppered, it may be preserved for a long time free from change. The solution should not be too concentrated.

A solution suitable for the purpose is obtained by saturating hydrochloric acid at sp. grav. 1·11 with cuprous chloride. The liquid absorbs the gas very greedily.

The determination of carbonic oxide in gaseous mixtures whose other constituents act neither chemically nor mechanically upon the cuprous chloride offers no difficulties. Less easy is the determination when other absorbable gases are present. The error which might arise from the presence of carbonic acid may be evaded by saturating the solution of cuprous chloride previously with carbonic acid. Oxygen has a very disturbing influence, and must be removed before the determination of the carbonic oxide. This was effected by allowing the gaseous mixture, before its entrance into the measuring-tube, to pass through a Liebig's potash-apparatus filled with the solution of pyrogallic acid in potassa-lye. In this manner oxygen, carbonic acid, &c., were absorbed and only carbonic oxide, hydrogen, and nitrogen passed on into the measuring-tube. The amount of carbonic oxide was then determined in the gas so treated, while the oxygen, carbonic acid, &c., were determined in separate portions of the original gas.

PROCEEDINGS OF SOCIETIES.

YORKSHIRE COLLEGE OF SCIENCE.

A GENERAL meeting of the Council was held on July 24 for the election of a Professor of Chemistry. The Members of the Council present were Ald. Barran (in the Chair), Messrs. O. Nussey, F. Lupton, Walter Rowley, G. H. Nussey, T. Salt, jun., T. Scattergood, F. W. Fison, E. Crossley, R. Reynolds, and H. H. Sales (Secretary). After full discussion, Dr. T. E. Thorpe was elected to the Professorship.

Dr. Thorpe formerly held a Demonstratorship of Chemistry in the Owens College, Manchester, and was associated with Professor Roscoe in his photo-chemical investigations, his research upon vanadium, &c. In the prosecution of researches upon the chemical action of light, he conducted an extended series of photometric experiments at Pará, in the Brazils, and, on the Royal Society advising the continuance of these experiments, and voting a grant in aid, he carried out a second series of measurements at Lisbon. He has made a series of determinations of the amount of carbonic acid in sea-air. For this research he was awarded the Dalton Senior Chemical Scholarship in Owens College. In 1870 he formed one of the members of the Government Eclipse Expedition to Sicily, and made a series of photo-chemical measurements, the results of which were printed by the Royal Society in their *Transactions*. Dr. Thorpe prosecuted his chemical studies under Professors Roscoe, of Manchester; Bunsen, of Heidelberg; and Kekulé, of Bonn, in whose laboratories he worked upwards of seven years. Conjointly with Professor Kekulé, he published a memoir upon ethyl-benzoic acid. Dr. Thorpe has for the last four years had the direction of large classes in theoretical and practical chemistry at the Andersonian University, Glasgow. For two years he has held one of the Secretaryships of the Chemical Section of the British Association for the Advancement of Science. Dr. Thorpe is the author of " A Manual of Inorganic Chemistry," " A Text-Book of Quantitative Chemical Analysis," and other works. He is also the writer of many original scientific papers in the *Philosophical Transactions* and *Proceedings of the Royal Society*, in the *Journal of the Chemical Society*, in the *Philosophical Magazine*, and other scientific publications.

NOTICES OF BOOKS.

Fourth Annual Report of the Deputy Master of the Mint. 1873. London: Her Majesty's Stationery Office.

THIS interesting report contains the " Memorandums " of the Superintendent of the Operative Department, and of the Chemist to the Mint; the general account of receipts and expenses; the silver and bronze coinage accounts; statements of Consolidated Fund advances for the purchase of bullion, &c.; statements of moneys coined: opinion of bankers on coinage of half-crowns and florins; results of the trial of the Pyx: certificate of the verification of the new trial plates of gold and silver by the Goldsmith's Company; reports from the Sydney and Melbourne branches of the Royal Mint; and report of a Committee of the United States Senate on the valuation of the pound sterling.

We turn naturally to the memorandum of Mr. Chandler Roberts, the able and indefatigable chemist to the Mint. We find that the total number of assays of gold and silver executed during the year has been 14,272. No gold has been set aside on account of brittleness, the two million ounces melted up into bars having consisted almost entirely of " scissel," or scraps of metal which had been already found suitable for coinage. The experiments commenced last year on the spectroscopic assay of gold have been carried on with success, and the results will shortly appear in the *Transactions of the Royal Society*. They confirm the opinion expressed by Mr. Roberts on a former occasion that differences of composition amounting to less than 1-10,000th part may thus be determined. We need not say that the successful introduction of the spectroscope as an instrument of quantitative analysis is a step of the highest value, all whose results it is as yet impossible to forsee. Mr. Roberts calls especial attention to the valuable services in this investigation rendered by the Assistant Assayer, Mr. E. Rigg.

The composition of the new trial plates for verifying the coinage has engrossed a large share of the time and attention of the department. The silver plate prepared is in comparison with the absolutely pure silver of M. Stas as 999·95 to 1000. Some difficulty was experienced in obtaining an alloy of gold and copper, which, when cast into bars and rolled out should be homogeneous in all parts. The plate actually prepared varies in composition in different parts from 916·5 to 916·7 parts of fine gold in 1000, the mean variation from standard (916·66) being 1-25,000th of the whole mass. More than a thousand assays were made in order to ascertain the purity and accuracy of the plate.

Mr. Roberts quotes the interesting results obtained by M. Levol, of the Paris Mint. This chemist finds that whilst a silver-copper alloy containing 71·893 per cent of the former metal is homogeneous, in all alloys containing more silver than this amount the centre of the solidified mass is richer than the exterior. The molecular arrangement of silver-copper alloys is represented in two plates, which will be of great value to metallurgists.

A mass of 112 ozs. of the silver-copper alloy melted, carefully stirred, and allowed to solidify, was found not to be homogeneous. The silver was found accumulated at several points which do not bear any apparent relation to the geometrical form of the mass. A homogeneous plate was at last obtained by the artifice of assaying all parts of a rolled plate of standard silver, and cutting off those parts which were found not to vary from the required standard. Further experiments upon a series of silver-copper alloys are still in progress.

Perfectly pure gold was obtained by reducing the chloride of gold with oxalic acid, and fusing in a clay crucible with bisulphate of potash and borax. The electrolysis of cyanide of gold and potassium gave a product containing 999·90 of fine gold in 1000, whilst reduction of the chloride with sulphate of iron and subsequent fusion gave only 999·85.

We strongly recommend this "Memorandum" of Mr. Roberts to the attention of all who are concerned with the metallurgy of gold and silver.

CORRESPONDENCE.

ON THE CHEMICAL EXAMINATION AND COMPARATIVE COMPOSITION OF SOME SPECIMENS OF PRESERVED MEAT.

To the Editor of the Chemical News.

SIR,—I have no desire to prolong the discussion on the above subject with Mr. Moore, and therefore will only say a few words in reply to some of the points referred to in his last letter, on the understanding that, so far as I am concerned, this communication will close the correspondence.

(1). In substantiation of my position as to the necessity and value of fat as an element of food, I quoted, in my reply to Mr. Moore's first letter, four credible authorities, each of whom asserted views in direct opposition to those of my critic. In his reply Mr. Moore thoroughly ignores three of them, notwithstanding that their terms of expression are plain and unequivocal; and the third (Lehmann) he disposes of with a remark on his verbal indefiniteness. Further, he quotes, in support of his view, a paragraph from Dr. Thudichum's work on "Chemical Physiology." Now, from my knowledge of this author's writings, I have come to entertain the highest respect for everything he says, but that very respect would make me very cautious not to quote anything he has written in a garbled form. The passage, as Mr. Moore gives it, is "Chemical Physiology," p. 45):—"Fat in tissue may originate in several ways; it may have been eaten with the food, and after absorption have only been carried to the cells, or it may be formed from sugar, dextrine, and glykogen; or, lastly, it may owe its existence to the decomposition of albumen." As given in Dr. Thudichum's work, the passage reads:—"Fat in tissue may originate in several ways; it may have been eaten with the food, and after absorption have only been carried to the cells; or it may be formed from sugar, dextrine, and glykogen; or, lastly, it may owe its existence to the decomposition of albumen. Thus the cholic acid of bile might easily yield any of the fatty acids, and sugar the glycerine. *But the proofs of any of these processes have not yet been furnished.*"—("Chemical Physiology," p. 45.) It will be noticed that the last sentence (which Mr. Moore strangely omits in his quotation) has a very important bearing on the interpretation Dr. Thudichum desires to be put on the preceding statement. It is quite unnecessary for me to repeat what I have already put forward on this matter. Neither in my original paper, nor in my subsequent communication, did I deny the formation of fat in the body (and no one familiar with the literature of the subject would do so); but what I did maintain was that fat is an indispensable dietetic element. Dr. Letheby illustrates this so plainly and forcibly in his lectures on "Food," that I cannot refrain from giving the passage. "Again, the mixture so usual in Ireland and Alsace of butter-milk and curdled milk and potatoes, and the combinations of rice and fat which make the diet of eastern nations—even the little dab of butter upon the poor man's potato, and the bit of cheese that he eats with his dinner—are matters not of luxury but of necessity, and they show how by long ex-

perience we have at least learnt to adjust the proximate constituents of food; so as best to maintain the health and vigour of the body."—(CHEMICAL NEWS, vol. xviii., p. 220.)

(2). Mr. Moore says—"I admitted, in my former letter, that chemically they (creatin and caffeine) had a resemblance, but what I objected to was that creatin had been compared with caffeine in its physiological action; it has no parallel; the one is an alkaloid of an active nature, the other a poison which has to be got out of the system as soon as possible, and therefore it is indeed a great error to state that it is useful as a stimulant in meat extract." Well, if Mr. Moore will turn again to his former letter, he will find that he did object to their resemblance chemically, for he used the following words :—"He says they contain an alkaloid (?)—creatin—corresponding in *chemical relationship* with theine and caffeine. *This is quite incorrect*; in Strecker's researches," &c. But, as Mr. Moore may view this contradiction on his part as a small matter, I will take his last statement, viz., that he objects to creatin being compared to caffeine in its physiological action, and ask him to compare it with the following extract from a paper by Dr. Thudichum, for whose views on this subject I trust he will have some deference :—"The effect of tea would be mainly due to the theine which it contains, and would consist in an acceleration of the heart's action and greater vivacity of mental powers. A similar effect would be produced by beef-tea, but not so much through its influence on the heart, as through its influence upon the nerves of taste and digestion, and upon the muscular sense, or sense of strength. . . . The effect of beef-tea on children and invalids is due to the specific effects of certain ingredients contained in it, especially creatin, the action of which in some degree resembles that of theo-bromine in cocoa. The creatin, which when in the system is changed into creatinine, has perhaps an action upon the muscles, of which it is a constituent. . . . We have therefore, as far as our present knowledge goes, to rely for an explanation of the efficiency of beef-tea upon these principles, viz., creatin, creatinine, para-lactic acid, inosic acid, inosite, and potassium salts. Which of these are essential and which are not we cannot at present tell."—(*Journal of the Society of Arts*, vol. xv., p. 238.) These extracts—from an authority Mr. Moore himself quotes—I hold sufficiently warrant any comparison I made of the physiological action of creatin and caffeine, and also show that Mr. Moore's views as to the action of the former have a slight tinge of heterodoxy about them; but perhaps he will say that Dr. Thudichum's statements also contain a "great error," or "are rather out of date now."

(3). In his first letter, Mr. Moore referred to certain experiments of Bogoslowsky's, "in which," he said, "warm water acted in exactly the same way as extract of beef solution," and in both his letters he makes various statements regarding creatin and the other bodies present in the extract of beef, which, if they have any meaning at all, indicate that he sets little value upon this substance in the way Liebig and others have valued it, and yet in his last statement he declares, "in the capacity of medical officer to an asylum containing 2000 patients, . . . I have decided to give preference to a beef-tea freshly prepared from fresh beef, rather than to an extractive carnis of the kind under discussion." Why does he give his patients beef-tea at all if its constituents are of the questionable character he insists they are? Certainly his practice is very different from his written opinions. Not only does Mr. Moore in his letters boldly set at defiance the views of some of the highest authorities, but he even (as I think I have shown) flatly contradicts himself. Verily, this is "the courage of one's opinions" with a vengeance !

Mr. Moore complains of "harsh strictures;" if he lives in a glass house he shouldn't throw stones. And perhaps on any future occasion when he attempts to make "a courteous explanation of errors," he will avoid using the terms "no justification," "greater error," and so forth, until he is certain his own ideas have some ostensible

foundation, and are not in direct opposition to the teachings of the recognised leaders in science.—I am, &c.,

THOMAS ROBERTSON OGILVIE.

Chemical Laboratory, Greenock,
　　July 22, 1874.

ESTIMATION OF TANNIN.

To the Editor of the Chemical News.

SIR,—I have only just had my attention drawn to an article "On the Estimation of Tannin," by C. Estcourt, F.C.S., in the CHEMICAL NEWS, vol. xxix., p. 109. Though rather out of date, you will, perhaps, allow me space for a few remarks. It is now long since I tried a process identical with that described (*i.e.*, titration by Löwenthal's method before and after precipitation of the tannin by gelatin) and failed in getting any useful results, doubtless from the reason suggested by the Abstractor in the *Journal of the Chemical Society* for July. That tanno-gelatin is largely soluble in excess of gelatin. A much more satis-factory method, and one which has been in use in our tannery for some time as a check on the simple Löwen-thal's, is the following :—

A piece of thick hide, thoroughly cleansed from albumen by lime (" glue-pieces "), is rasped into coarse powder; about four times the weight of the supposed amount of tannin is taken, softened with 50 c.c. of distilled water and 50 c.c. of the tannin infusion is added. After the lapse of some hours, the mixture is filtered or strained through muslin, a double portion of the filtrate taken, and titrated with permanganate and indigo. The difference gives the quantity of tannin absorbed by the hide, which, if the hide be in sufficient excess, should be the whole present. The filtrate will in this case give no precipitate with gelatin solution. The operation should be conducted in the cold, and the hide at no time exposed to heat.

I do not give this as an entirely satisfactory method—so far as I know, such a one is yet to be discovered—but it is one which is really workable. The chemistry of the numerous tannins is yet in a thoroughly unsatisfactory condition, and it is useless to attempt to estimate accu-rately a very varied class of bodies with different, and mostly unknown, combining equivalents.

Where numerous Löwenthal determinations have to be made, much time and trouble is saved by blowing air through the liquid with an aspirator, in place of the con-stant stirring which is otherwise absolutely necessary.—I am, &c.,

HENRY R. PROCTER, F.C.S.

North Shields, July 21, 1874.

THE ADULTERATION ACT.

To the Editor of the Chemical News.

SIR,—The conclusions arrived at by the Parliamentary Committee on the Adulteration of Food Act must have had a startling effect upon the majority of chemists who have an interest in the enquiry, and no doubt many have asked themselves how they are to be protected from the indignity of having to submit to examinations dictated by chemists probably much wanting in skill in the analysis of articles of food.

I see, by your last issue, that a correspondent suggests the inauguration of an Association of Analytical and Con-sulting Chemists, and to place the selection of Public Analysts in the hands of this Association. The idea is a good one, but how is it to be worked out ? Anyone acquainted with the constitution of the Chemical Society will be aware that nothing can be done by that body, and as it is the only institution possessed by English chemists, it is evident that whatever is done in the matter must be the result of independent action. Let us hope, then, that such men as Allen, Hassall, Wanklyn, and others, well known as Food Analysts ,will not allow this subject to go by default; but will come vigorously to the front and

strike for the right, for it must be evident to anyone who has even glanced at the subject of food analysis that only skilful operators in this particular branch of chemical science can possess the knowledge requisite to prove and thoroughly test the fitness of any candidate for the office of Public Analyst.—I am, &c.,

W. F. K. STOCK.

Chemical Laboratory, Darlington,
　　July 27. 1874.

ADULTERATION ACT, 1872:
REPORT OF THE SELECT COMMITTEE.

To the Editor of the Chemical News.

SIR,—As the result of a preliminary meeting of Public Analysts held yesterday, we are directed to announce that a general meeting of the Public Analysts of the United Kingdom will be held on Friday, August 7, at the Cannon Street Hotel, at 4 p.m., with a view to the formation of a society for mutual assistance and co-operation. The chair will be taken by Professor Redwood. Circulars notifying this meeting are sent this day to all Public Analysts whose addresses are known, but, if any are accidentally omitted, the announcement of the meeting in your columns will supply the omission, and we shall be happy to furnish all particulars to any gentleman who will communicate with us.—We are, &c.,

CHAS. HEISCH,
G. W. WIGNER,
Honorary Secretaries *pro tem.*

79, Great Tower Street, London,
　　July 29, 1874.

[A full report of this meeting will appear in our columns. —ED. *C. N.*]

SOLIDS IN MILK.

To the Editor of the Chemical News.

SIR,—From the Report of the Select Committee on the Adulteration Act, it would appear that the Committee are prepared to endorse the statement that the total solids in genuine milk may fall as low as 10 per cent. Within the past twelve months I have made careful determinations of the solid residue in over fifty samples of milk (all of which I knew to be genuine) from a great variety of sources, and in no case have I found the total solids to fall so low as 11 per cent.

Can any of your numerous readers give me an authen-ticated instance of milk with only 10 per cent of solids being obtained from a cow not suffering from disease ; or of the mixed milk of a number of cows yielding much less than 12 per cent solid residue.—I am, &c.,

J. R. LEEBODY, M.A.,
Public Analyst for the City and County
of Londonderry.

Magee College, Londonderry,
　　July 25, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwis expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, June 8, 1874.

Distribution of Heat Developed by Shock.—M. Tresca.—In forging the ingot of platinised iridium re-cently presented, oblique luminous bands were observed on the lateral surfaces, crossing each other, while the piece was still at a dark red. The zone that becomes luminous is probably that in which the principal sliding (*glissement*) of matter occurs, at the moment of change o form, according to a law the author has formerly ex

pounded; and, should this be confirmed, such observations may furnish more exact knowledge of the mode of deformation produced in forging. The exceptional hardness of platinised iridium cooled to a dark red requires, for equal deformations, a work at least equivalent to that in the forging of steel; and, owing to the comparatively small calorific capacity of the alloy, this work must appear in calorific phenomenon that are more localised and intense. Besides, the matter is more homogeneous than iron, and shows a very remarkable kind of translucidity, which makes one believe he can follow the red colour to a certain depth. The effects are thus rendered more manifest; especially as they are not accompanied by an exudation of interior matter and an oxidation of the surfaces. They are doubtless observable in other metals, though less distinct.

Memoir on the Means of Counteracting the Invasion of Phylloxera.—M. Dumas.—(Extract.) Sulphhydrate of ammonia, generated slowly in the ground near the roots, is the surest poison for destroying the insect without hurting the vine. Sulphuret of carbon gives vapours that are undoubtedly efficacious, but it is necessary to associate substances with it that diminish the tension, and specially resinous or oily soaps with a base of potash; most suitably used in rainy weather. Sulphocarbonate of potassium, lastly, is recommended. M. Dumas advises, as a *preventive* measure, in healthy land where the disease has entered, the destruction (by police authority) of every diseased stock and those about it, and poisoning of the ground; as a *repressive* measure, in invaded land, the simultaneous use of manures to strengthen the vine, and poisons to kill the insect; and, as *precaution* for the future, the planting at present of new vines of French races only in land susceptible of being flooded, or in land naturally or artificially sandy (the immunity of which various researches have confirmed.

Progress of the Vine Disease During Winter; Practical Means of Opposing it.—M. Marès.

Small Movements of a Material System in Stable Equilibrium.—M. Lucas.

Modification of the Commutator of Clarke's Machine.—M. Barthelemy.—He reduces it to a cylinder of wood having two metallic cheeks. It is fixed, and is so arranged that the two cheeks are separated in a horizontal plane; that is, one in which the current changes direction in the bobbin wire. Dolls fixed to these cheeks are the poles of the exterior circuit. The two ends of the bobbin wire turn with it in its diametral plane, and are applied to the surface of the cylinder. In this way the ends of the wire change plate at each half rotation; that is, at the moment when the current changes direction; consequently one of the dolls will always be the positive pole of the exterior surface, and the other the negative.

Employment of Sulphuret of Carbon for Counteracting Phylloxera.—M. Chefdebier.

Employment of Sand in Treatment of Vines Affected by Phylloxera.—M. Lichtenstein.

Friction in the Shock of Bodies.—M. Darboux.—A mathematical note.

Note on the Spectrum of Coggia's Comet.—M. Rayet.—On May 19 the light gave a continuous spectrum from the orange to the blue (spectrum of solid nucleus), traversed by three bright bands (spectrum of gaseous nebulosity); but the continuous spectrum was very narrow compared with ordinary nuclear spectra; and the luminous bands, instead of being stumped towards the more refrangible side, terminated, towards red and violet, in very distinct straight lines. The author describes some further observations on June 5, mainly confirming those now given.

Movement of Air in Tubes.—M. Bontemps.—(Continuation.) The mechanical work of the interior current is proportional to the *vis viva* of the mass of air in motion, and this is proportional to the difference of the extreme

pressures. The preceding analysis shows in the current two elements which must not be confounded:—(1) The *intensity*, quantity in weight, made to flow out per second, which follows Ohm's law; from the mechanical point of view it is a quantity of motion. (2) The *mechanical work*, or *vis viva* of the current; which follows the law of Torricelli, corresponding, in hydronamics, to that of Joule in the theory of the electric current. When a current is to be measured, it is necessary to determine these two elements. If one uses an anemometer or a gasometer it is the mechanical work which is measured. The experiments verify Torricelli's law; with the anemometer it is evident, with the gasometer an explanation is required. The velocity is extinguished under a large receiver resting on water, and in which pressure and temperature are constant. The volumes which flow are not proportional to the intensity, but, brought to a constant temperature, they are in exact proportion to the temperatures and the squares of the velocities which the different currents possess at issuing; that is, at once to the interior energy and the *vis viva* of translation. Then, to measure intensity, it is necessary to take the current in the active state, either using it to modify another current, the rate of passage of which is known (as in the galvanometer), or by transforming it into a flux of another nature which one can measure (as in the voltameter). The siren is an instrument of the second kind. When the charges are varied under which it sounds, the pitch of the sound varies with them; it is the property of intensity according to Ohm's law. *En resume*; we establish a parallelism between the electric current and the current of air. In the former there is electricity transformed and energy lost, which is found in the form of heat liberated. In the latter there is similarly, air transmitted and energy lost, which is found in the form of mechanical work or of heat liberated when the velocity is extinguished. These two elements are in constant relation in each section.

A Physiological Peculiarity of Axoloth.—M. Dareste.—The animals, at the time of reproduction, have their cloaca filled with a mucous matter, coloured more or less red by blood corpuscles, showing a true hemorrhage.

Reimann's Farber Zeitung, No. 19, 1874.

Detection of Saffranin.—Saffranin in substance may be distinguished from magenta by placing a few particles in a watch-glass, and adding about 6 drops of concentrated sulphuric acid. The salts of rosaniline dissolve with a brownish-yellow colour, whilst the solution of saffranin is at first green, and subsequently turns blue. The dilute alcoholic solution of rosaniline salts, if placed in a test-tube, appears of a transparent crimson both by transmitted and by reflected light. Similar solutions of saffranin, however, are rose-coloured and transparent by transmitted light, but if viewed by reflected light appear turbid, opaque, and scarlet. To distinguish these two colours upon the fibre, the swatch is boiled with alcohol in a test-tube, and the solution examined both by reflected and by transmitted light. The following reactions are useful in corroboration:—Soap-lye containing 5 per cent of soap, at a gentle heat, renders fabrics dyed with magenta paler, and becomes coloured itself. In case of saffranin the swatch is unchanged, and the liquid remains colourless. If the swatches are heated with soda-lye magenta is nearly or altogether discharged, while saffranin is little affected. If the swatches are placed in water acidulated with pure hydrochloric acid, and a piece of sheet zinc added, magenta is quickly decolourised, while saffranin remains for some time unaltered, and ultimately turns to a beautiful yellow.

There are receipts for dyeing medium and dark blue and light brown on woollen and mixed doubles; for orange and wood-green on cloth; for green and olive on garments with cotton warps; for printing a black on wool without steaming; for a fast blue on wool, and a gold yellow on silk.

Manufacture of Artificial Alizarin.—Meister Lucius, and Bruning are now working the following process:—Purified anthracen, melting between 207° and 210°, is heated for three hours in vessels of clay or enamelled iron with ¼ its weight of bichromate of potash, and 12 times its weight of nitric acid of sp. gr. 1·05. The crude anthrachinon which results is dissolved in 6 parts of boiling nitric acid of sp. gr. 1·5. The solution is known to be fully effected when a sample taken out does not deposit any anthrachinon as it cools. The liquid now contains mononitro-anthrachinon, which is separated as a yellow precipitate on adding water. This precipitate is washed and dried, and heated to 170° to 222°, in suitable vessels, along with 9 to 12 parts of solution of caustic soda of sp. gr. 1·3° to 1·4°. This part of the process is complete as soon as a sample shows no increase of precipitate on the addition of hydrochloric acid. The mass is cooled, dissolved in boiling water, filtered, and the colour is thrown down by the addition of an acid to the hot filtrate. The yellowish-brown precipitate is washed, and may then be immediately used for dyeing. Pure alizarin may be obtained by extraction with ether. The alkaline mass remaining on the filter consists chiefly of anthrachinon. It may be nitrised again, and submitted to further treatment, The acid mother-liquor of the mononitro-anthrachinon, and the acid obtained by condensing the vapours escaping during the oxidation of the anthracen, can also be utilised.

No. 20, 1874.

This number contains a continuation of the paper on dyeing and finishing plushes. There are further receipts for a sulphur yellow on silk; a blue on mixed silk and cotton garments; a magenta ponceau on cotton; for finishing bookbinders' linens; and a medium and dark green for printing woollens.

Gazzetta Chimica Italiana, Anno iv., Fascicolo 4, 1874.

Mode of Action of Sulphur upon Carbonate of Lime.—Prof. E. Pollacci.—A critique on Prof. Cossa's letter to Canizzaro, published in Fasci. i. and ii. of the *Gazzetta Chimica.*

Action of Sulphur upon Carbonate of Lime.—Dr. G. Bellucci.—The author concludes that sulphur enters into a true reaction with carbonate of lime, producing sulphate at ordinary temperatures, and in long periods of time (seventy-five to eighty days), and that the presence of organic matter favours the reaction.

Chemical Analysis of a Maritime Plant (Posidonia oceanica).—Fausto Sestini.—

Water	26·15
Fatty matter extracted with ether ..	2·55
Albumenoid matters (calculated on 15·5 per cent of nitrogen)	3·77
Hydrocarbonates (cellulose, starch, dextrin)	61·26
Ash..	6·27
	100·00

Certain Derivatives from Phloretin.—Ugo Schiff.—The author describes the preparation of phloretin, of phloroglucin and phloretic acid, phloroglucide, and triphloretide.

Liebig's Annalen der Chemie und Pharmacie.
May 9, 1874.

Salts of Parabanic Acid.—N. Menschutkin.—The author describes parabanate of ammonia, its conversion into oxalurate of ammonia by contact with water, and into oxaluramid by exposure to heat; the parabanate of potash and its conversion into oxalurate of potash; the parabanate of soda; and the bi- and mono-silver salts.

Oxalurate of Potash, and on the Determination of the Alkalies in the Salts of Acids Belonging to the Uric Acid Group.—N. Menschutkin.—After describing the composition, properties, and crystalline form of the oxalurate, the author remarks that Strecker's method for the analysis of this salt is far from satisfactory. Alkaline parabanates and oxalurates yield on ignition metallic cyanides. Strecker determines the potash by simple ignition, calculating the residue as carbonate of potash.

Oxidation Products of Colophonium and Oil of Turpentine.—Dr. Jos. Schreder.—From colophonium (common resin) the author obtains trimellithic acid, $C_9H_6O_6$, and from turpentine, terebinic acid and terephtalic acid.

Conversion of Cinchonidin into an Oxy Base.—Dr. Joh. Skalweit.—The base obtained, bioxycinchonidin, $C_{20}H_{24}N_2O_3$, agrees in composition with Schützenberger's oxychinin.

Researches from the Tübingen Laboratory.—Communicated by Rud. Fittig.—These researches include a notice on the cyan- and carboxyl derivatives of diphenyl by O. Dobner; a paper on normal phenyl-propylic alcohol, by L. Rügheimer; one on attempts at the synthesis of allyl-benzol, by R. Fittig; and researches on the constitution of piperin and its products, piperic acid and piperidin, by R. Fittig and W. H. Mielck.

Desulphurisation of Dicarboxyl-Sulpho-Carbanilid. P. Griefs.—The author has repeated the experiments of Rathke and Schäfer on the action of sulpho-carbonyl-chloride upon amido-benzoic acid, without being able to confirm their results.

Tetra-Iodide of Carbon.—M. G. Gustavson.—This compound forms dark red crystals, which, if small, take a lighter shade. Its powder is a bright vermillion. The crystals are octohedral, belonging to the regular system. The specific gravity is, at 20·2°, 4·32.

Moniteur Scientifique, du Dr. Quesneville,
May, 1874.

Chemical Products at the Vienna Exhibition.—M. E. Kopp.—Not capable of useful abstraction.

Oxypheno-Sulphites of Ortho- and Paratoluidin.—M. T. Lecco.—The author has examined the action of oxypheno-sulphurous acid upon the salts of toluidin, in the hope of obtaining new sulpho-conjugated acids.

Determination of the Melting-Points of Certain Alloys, as those of Lead and Tin.—M. R. Gnehm.—

Alloy.		Point of Softening.	Point of Fusion.
Tin.	Lead.		
2	5	185	189
2	6	189	194—195
2	7	192	198
2	8	202	208—210

Detection of Bitter Substances other than Hops in Beer.—M. Kubicki.—This valuable paper is too lengthy for insertion.

Contamination of Streams by the Refuse of Manufactures and of Towns, with Remedial Methods.—F. Fischer.—A prolix repetition of the exploded errors of certain English authorities on the sewage question.

Part Played by Phosphorus and the Phosphates in Putrefaction.—M. Jules Lefort.—Not adapted for abstraction.

Fixation of Iron and Alumina Mordants upon Calicos.—Chocolate-reds, blacks, purples, and catechu dyed up in madder, garancin, and alizarin are aged for forty-eight hours at 32° of moisture, and 35° of heat by the psychrometer. Double roses and brightened reds are aged for forty-eight hours, with 27° moisture and 30° heat. Aniline blacks require twenty-four hours with 28° moisture and 38° heat. Madder reds, or alizarin along with aniline

black, require, first, twelve to eighteen hours with 30°
moisture and 36° heat, and then twenty-four hours at 27°
moisture and 30° heat. Where space is an object, the
time required for ageing may be shortened by adding to
colours containing iron mordants—chocolates and purples
—1-12th of the following oxidising mixture :—

Crystals of soda	4·2 kilos.
Arsenious acid	2·8 ,,

Dissolve with heat, and add—

Water	36 litres.
Roasted farina (dark)..	17·5 kilos.
Chlorate of potash	3·2 ,,

Add to the colour when about to be used. Alumina mor-
dants may be fixed by exposing the printed pieces to am-
moniacal gas. Iron mordants may be fixed without
moist ageing by dunging them in a mixture of silicate of
soda and liquid ammonia, but this process has not, hitherto,
been successfully applied to alumina mordants and to
aniline blacks.

New Process for the Preservation of Timber.—
M. A. Hatzfeld.—The author recommends saturation
with astringent solutions and sulphate or pyrolignite of
iron.

June, 1874.

Chemical Products at the Vienna Exhibition.—
E. Kopp.—An account of the contributions from Italy,
Belgium, Holland, Denmark, Norway and Sweden,
Russia, Spain and Portugal, Greece, Turkey, Egypt,
North America, and Switzerland.

**Effect of Certain Reagents upon Artificial Colour-
ing Matters Fixed upon Wool, Silk, and Cotton.—**
M. M. Bibanow.—The colours experimented upon were—
saffranin, Magdala red, Hofmann's violet, Poirier's violet,
dimethylaniline violet, diphenylamin blue, methyl-
diphenylamin blue, iodine green, and dimethylaniline
green. All the swatches of silk were dyed without mor-
dant, except in the case of iodine green. The wools were
in like manner dyed without mordant, except for the two
greens, which were fixed by steeping in a solution of
hyposulphite of soda, and adding afterwards sulphuric
acid. Part of the cotton was mordanted with albumen,
and part with tannin. But for dyeing blues with the
alcoholic solutions of diphenylamin, and methyl-diphenyl-
amin, no mordants were employed. The reagents tried
were—acetic acid, hydrochloric acid, nitric acid, chromic
acid, caustic soda, ammonia, sulphide of sodium, chloride
of tin, perchloride of iron, and bleaching lime. We regret
that want of space prevents us from giving the results,
which are arranged in the form of tables.

Theory and Practice of Vinegar Making.—P. Pfund.
—A very valuable paper, but too lengthy for insertion.

Detection of Prussic Acid.—H. Struve.—An impor-
tant toxicological paper. The author has succeeded in
demonstrating the presence of sulpho-cyanogen, not
merely in the saliva, but as a possible constituent of the
blood. Hence, in chemico-legal investigations on the
presence of prussic acid, the sulpho-cyanide test should
always be confirmed by the production of prussian blue.

**Fixation of Iron and Alumina Mordants upon Cot-
ton Tissues.—**After exposing the pieces in moist ageing-
rooms, it is prudent, in order to ensure regular work, to
dnug and dye swatches in order to see if they have been
sufficiently oxidised. If this is not the case, either the expo-
sure must be prolonged, or supplemented by the addition
of oxidising agents to the dung-bath. For garancin-
catechu styles, in case of imperfect oxidation, 1 to 2 grms.
of bichromate of potash per litre to the dung-bath. If the
oxidation of purples, garnets, and all colours requiring an
iron mordant is incomplete, 5 to 10 grms. of hypochlorite
of ammonia are added to the dung-bath per litre. The
hypochlorite is thus prepared :—Chloride of lime, at
5½° B., 100 grms. Add by degrees 40 grms. sulphate of

ammonia at 12 B. The sulphate of ammonia is made by
gradually adding to 140 grms. of liquid ammonia 50 grms.
of sulphuric acid diluted with 150 grms. of water. It is
evident that oxidation by ageing requires much care. In-
stantaneous oxidation by treatment with chlorate of
potassa is comparatively easy. The following procedure
has given good results for several years. The pieces are
worked through the following bath :—

Water	7 litres.
Chlorate of potassa	60 grms.
Chloride of magnesium (15° B.)	¼ litre.
Nitrate of ammonia	30 ,,

The pieces are then dried and printed with the requisite
mordants of iron and alumina. For reds with acetate of
alumina, more tin crystals are required if the oxidation is
effected by this mixture than by exposure in the ageing-
room. This oxidation with deliquescent salts has the
advantages of economising garancin to the extent of 600
to 700 grms. per piece of 100 metres for puce grounds.
A chlorate of soda may be economically prepared as
follows :—Hypochlorite of soda is first made from chloride
of lime and carbonate or sulphate of soda, and the clear
liquid is boiled until entirely converted into chlorate.
When the oxidation is completed, and the " colours "
printed on, the pieces are dunged to complete the fixation
of the mordants, and to remove the thickening and every-
thing which is not combined with the fibre. The mixture
of cow-dung and chalk has been in many styles success-
fully replaced by silicate of soda. The following propor-
tions are employed for dunging double roses (alizarin and
fleur de garance), and for reds and cleared blacks. The
dunging with silicate of soda is carried on in two vats
fitted with rollers, and communicating by a tube 5 centi-
metres in diameter. Each vat contains 4500 litres of
water. The first of these is charged with 40 litres silicate
of soda at 20° B., and the second with 30 litres at the
same strength. A piece passes through these vats in
three minutes. Light patterns are then washed once, and
heavy ones twice. They are dunged a second time for
twenty minutes at the temperature of 50° C. in an ordinary
beck containing 600 litres of water, to which have been
added 3 litres silicate of soda at 20° B. The pieces are then
washed twice. If the patterns are heavy, a third dunging
is applied with the same proportions as the second.
Then follow two more washings. For garancin styles,
black-browns, catechus, and purples, and for browns got
up with fleur or with alizarin, the dunging is performed
as above described, using for the first vat 60 litres silicate
at 20° B., and for the second 50. In England, especially,
a mixture is used of phosphate of lime and soda, arseniate
of potash or soda, and chalk. For garancin styles, and
heavy madder reds, this mixture gives very good results,
and corrects any insufficience of oxidation in the iron
mordants. The first bath is charged with 4500 litres of
water, and 5 litres of mixture A., and the second with the
same proportions, adding to each 5 kilos. of chalk well
ground up with water. The pieces are passed through at
75° C. and washed. They are dunged a second time in a
common beck at 60° C. for thirty minutes, taking—

Mixture A.	1 litre.
Water	800 litres.
Chalk	1 kilo.

They are then washed again, and passed for twenty
minutes through a beck water at 55°. The third dunging
for twenty minutes at 50° C. requires the same materials
as the second. After washing the pieces are then fit for
dyeing. To prepare the mixture A., dissolve in 20 litres
of boiling water—

Biarseniate of potassa	8 kilos.
Dung substitute	4 ,,

Add gradually, when cold—

Chalk	8 kilos.

and stir before using. All these operations ought, as far
as possible, to follow upon each other without much delay.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in treating and utilising sewage. Alexander Colvin Fraser, engineer, New Barnet, Herts, and William Watson, chemist, Great Ayton, near Northallerton, York. November 7, 1873.—No. 3632. The object of this invention is to render sewage commercially available in the manufacture of artificial manure and other manufacturing purposes by the economical elimination and treatment of the organic and oleaginous elements of the sewage, for which purpose aluminous schistus and the analogous oil or jet rock are calcined under atmospheric influence by the aid of peat, wood, or coal bats, the combined properties of which are sulphate of alumina, sulphate of iron, sulphate of magnesia, and sulphate of lime, with that of vegetable carbon. The above combined elements are, when necessary, saturated with dilute sulphuric acid, and intermixed with clay, sulphate of lime, or prepared dry mould. The improved preparation may be applied to the treatment of the sewage in the form of filter-beds, or in a pulverised state, or otherwise. The treated sewage, &c., may be used as manure or for other purposes.

Improvements in the manufacture of soap. Ulysses De Lungo, merchant, Cannon Street, London. (A communication from Gaetano Tardani, Rome). November 7, 1873.—No. 3633. For the improved manufacture of soap I take any convenient quantity of oil or other fatty matter, and place it in a flat-bottomed boiler in the form of a truncated cone, together with double the quantity of water, and a proportion of oxide of calcium or quick-lime, rendered previously slack by a certain quantity of water equal to the weight of the oil or fat. The whole must be boiled, and mixed by means of an agitator.

Improvements in preserving meat and other articles of food. Frederick John Money, M.D., Marlborough Place, Brighton. November 8, 1873.—No. 3643. These are removing the oxygen from the cases containing the articles of food to be preserved, and from the articles of food themselves, by the use of substances having a direct affinity for that gas; and using, if necessary, certain covering substances for urther protection.

Improvements in the manufacture of muriatic acid. John Young, Kelly, Renfrew, N.B. November 10, 1873.—No. 3654. The feature of novelty which constitutes this invention is the obtainment of muriatic acid from chloride of calcium, by mixing it with silica, heating it to redness, and submitting it to the action of steam.

Improvements in the manufacture of paper-pulp. Walter Weldon, Abbey Lodge, Merton, Surrey. November 10, 1873.—No. 3655. Boiling fibrous materials, instead of with caustic alkali, with lime dissolved in solution of chloride of calcium.

Improvements in the concentration and treatment of low class and unmerchantable ores and minerals. Thomas John Barnard, mineproprietor, Abbey Mount, Tavistock, Devon. November 15, 1873.—No. 3715. The object of my invention is the improved concentration and profitable treatment of ores and minerals, more especially those hitherto regarded as valueless substances. Throughout the kingdom, and more especially Devon and Cornwall, copper lodes contain an average of 4 to 8 ounces of silver per ton of stuff, but which has never been considered sufficient to pay for the cost of extraction. It is well known that the average quality of copper ores sold throughout the land to the smelters is about 7 per cent, and that repeated washings, dressings, and concentrations are resorted to upon the mines in order to arrive at this produce; consequently, much material is wasted, and any copper held in solution finds its way only into the rivers. The miner also gets no benefit whatever for the silver, and, as 1 to 2 per cent copper ore is unmerchantable or unprofitable, it is allowed to accumulate in "burrows" or heaps upon the mines as an unsaleable discarded article. I now proceed to describe my process. The comparatively unlimited copper ores containing only 1 to 2 per cent are equally as rich, or nearly so, for silver as the very limited higher copper-produce material. I therefore cause an average to be made of 50, 100, or more, tons of about 2 per cent copper ore, which is then roasted with common salt, and chloridised in the ordinary manner; this, of course, converts the silver as well as copper into a chloride. It is universally known that, by passing hot water through the chloridised stuff, the chloride of copper will be held in solution, and can be precipitated by metallic iron or zinc, but I cause strong wooden tanks to be made with false bottoms and, instead of hot water, I pass hot or boiling brine through the chloridised mass, which holds the silver as well as the copper in solution; this liquid is then conveyed through a long run of launders containing iron into a large wooden tank, and is kept hot by a jet of steam; and scrap iron or zinc in the tanks, as well as in the launders, throws down a copper precipitate of about 60 per cent copper, but containing several hundred ounces of silver to the ton, which is the great secret of success, as both silver and copper are concentrated, from a commercially-valueless article, into a product of great wealth, admitting of at once being treated by any of the ordinary well-known methods for the extraction of the silver from the copper. In conclusion, I desire protection for my invention, which I find by repeated practical experiments to be the only means of profitably treating the low-class ores herein described. I well know that even 10 ounces of silver contained in a ton of mineral cannot be extracted pure in a direct manner to afford any advantage or profit for the extraction, but the copper acts as an assistant to concentrate both itself and the silver, and thus will millions of ounces of silver now disseminated in minute particles, and scattered broadcast throughout the mineral kingdom, be concentrated, and ultimately converted into pure metal at immense profits, together with large quantities of copper hitherto regarded as valueless, for the benefit of the mining community, and whereby will be removed the great sting of speculation that has always been its bane. In order to prevent any infringement upon my discoveries, I would ask to be allowed to modify the minute details

for instance, some of the chloride of silver may be precipitated into a purer state by metallic copper before iron is introduced, but I claim that the only method of obtaining the low-class, hitherto valueless silver and copper ores to profit, is by causing (when they are not intimately associated by Nature) low-class silver and copper to be mixed together, and the precipitation of the copper as before described brings down the silver. Thus, 1 per cent of copper in a ton of ore, and 10 ounces of silver in another ton of ore, treated separately, end in a commercial failure, since the cost is more than the return; but 1 per cent of copper and only 4 ounces of silver in 1 ton of stuff can, upon a large scale as I have described, be worked to profit. The sequel will be proved by demonstrative facts, as my invention will bring millions upon millions of pounds' worth of silver and copper into commercial value, which have been known for ages to exist in their present state, but without any applied means for the profitable extraction of the same.

Improved processes for the extraction of iodine. Bristow Hunt, Serle Street, Lincoln's Inn, Middlesex. (A communication from Alvaro Francisco Carlos Reynoso, chemist, Paris). November 15, 1873.—No. 3717. This invention consists of certain improvements which may be divided into two groups, the first of which comprehends suitable methods for treating the ashes of varec (sea wrack) and other products in order to separate the soluble substances from others which are insoluble, and the second of which comprises wet processes which allow of the rapid precipitation of the iodide in a free state; and also the means of purifying the same and causing its crystallisation.

Improvements in treating sugar. Robert Speir, chemist, Greenock, Renfrew, N.B. November 15, 1873.—No. 3726. The feature of novelty which constitutes this invention is the treating of sugar with an alkaline solution for the purpose of removing the smell and taste of sulphurous acid.

Improvements in gas-heating apparatus for laboratory use. Thomas Fletcher, Warrington, Lancaster. November 17, 1873.—No. 3733. The features of novelty in this invention consist in a simple and compact of heating apparatus for laboratory use, which is capable of affording a wider range of heating power than has hitherto been practicable with a single apparatus, which is accomplished by having a ring of burners and a single jet of gas, either of which may be lighted inside a cylindrical casing, or the ring may be utilised for supplying gas, to be lighted above a wire-gauze covering, to such cylindrical casing on the Bunsen principle; and the pipe which supplies the single jet and its nozzle may be utilised as a blast-pipe for increasing the supply of air to, and consequently the heating-power of, such Bunsen flame.

TO CORRESPONDENTS.

⁎ Vol. XXIX. of the CHEMICAL NEWS, containing a copious index, is now ready, price 11s. 4d., by post, 12s., handsomely bound in cloth, gold lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxx. commenced on July 3rd, and will be complete in twenty-six numbers. READING CASES, price 1s. 6d. each, post free, may also be obtained at the Office.

THE CHEMICAL NEWS.

VOL. XXX. No. 767.

SUSPENSION OF CLAY IN WATER.*

By WILLIAM DURHAM, F.R.S.E.

It has been long known that pure water has the power of holding clay in suspension for an indefinite time, and also that salts of lime when added, even in small quantity, to water, destroys this power. I have made a considerable number of experiments on this subject, and the results appear to me extremely interesting.

The method of experimenting was very simple. A number of glass jars capable of holding about a pint of water each were used, and on each a numbered label was gummed looking inwards, so that on looking through the jar the number could be read when the contained liquid was clear enough. One jar was always filled with water only, and the others with solutions of various kinds and strengths.

A weighed quantity of fine white clay was added to each, well stirred up, and left to settle. The time was then noted which each solution took to clear sufficiently to allow the number of the label to be seen through it.

The following results were obtained from a great variety of experiments, using 10 grains of clay to each jar:—

(1). The clay rapidly separated into two portions; the greater part quickly settling down to the bottom of the jars, the lesser part remaining suspended in the liquid considerably longer.

(2). The power which water possesses of sustaining clay is *gradually destroyed* by the addition of an acid or salt. For example, by stirring the jar of water with a glass rod slightly wet on the point with sulphuric acid, the power of sustaining clay was considerably diminished; by adding one drop of acid it was still further diminished, while with two drops the power seemed completely destroyed as the water cleared rapidly.

(3). In solutions of sulphuric acid and sodium chloride of varying strengths the greater part of the clay sunk to the bottom of the jar, and the liquid became clear *in the order of the specific gravities* of the solutions, so that the *densest* liquid *settled* and *cleared last*. This effect was more decided in the acid than in the salt solutions.

(4). The power which water possesses of sustaining clay in suspension is *gradually increased* by the addition of small quantities of the alkalies, or their carbonates, and lime. Thus water having 3 grains of sodium carbonate in it was quite opaque for three days, while water only was seen through in about a day and a half.

(5). In solutions of sodium carbonate of varying strengths (and most probably in all alkaline solutions) the greater part of the clay sunk to the bottom, and the liquid cleared in the *inverse order of the specific gravities* of the solutions, so that the *densest* liquid settled and cleared *first*.

(6). Water whose power of sustaining clay had been destroyed by an acid had this power restored, in great measure, to it by the addition of any of the alkalies.

On substituting finely-powdered white silica for clay, the same general results were obtained, but in a much modified form as to the time of clearing, the silica settling much more rapidly in every case than the clay.

These remarkably contrasted actions of acids and alkalies have not been noticed before, so far as I know, and, besides being of much scientific interest, may be of practical importance. I have not been able as yet to discover the cause of these phenomena, but it appears to me

extremely probable that the clay, in falling through the water, generates, by friction, electricity; and, as water is a bad conductor, the difference in potential between the clay and the water continues for some time, hence they are mutually attracted; but, when acid or salt is added, the liquid becomes a good conductor, the potentials are equalised, and the clay falls. With the alkali, on the other hand, although the liquid does become a better conductor, it at the same time becomes a better generator of electricity, and it is only when, by adding a considerable quantity of alkali, the conducting exceeds the generating power that the potentials are equalised and the clay falls.

I hope to be able shortly to put this idea to the test of experiment.

The following are the results of two sets of experiments made with sulphuric acid and sodium carbonate, added in various quantities to the water:—

		Density.	Time of Clearing.	
			Hrs.	Mins.
Water only		1000	36	0
,, with two drops of acid ..		1000	0	30
,, with acid		1024	1	30
,, ,, ...		1048	5	0
,, ,, ...		1093	10	0
,, ,, ...		1440	36	0
,, with 1 gr. sodium carbonate		—	96	0
,, 5 grs. ,, ,,		—	112	0
,, 9 ,, ,,		—	93	0
,, 20 ,, ,,		—	46	0
,, 30 ,, ,,		—	22	0
,, 200 ,, ,,		—	4	0

As the result of many experiments, I find that every kind of solution has a specific capacity of sustaining clay, which capacity varies in a specific manner according to the strength of the solution.

ESTIMATION OF WATER IN PARAFFIN RESIDUES AND CRUDE PARAFFIN.

By J. CARTER BELL.

MANY of the discrepancies which exist in the results obtained from the analyses given by various analytical chemists arise from the careless manner in which samples are sent to them. In so simple an estimation as the above, concordant results could not have been obtained by two chemists unless they had worked upon the same sample and exactly in the same condition, as the following facts will prove:—

The paraffin residues which come over to this country from America often contain water to the extent of 13 per cent. In taking the sample from the cargo as it arrives in dock, it is well to take the sample from one hundred barrels. In one case, fifty barrels were bored at the end, and a sample taken from each: an iron pipette was put through the bung-hole to the bottom of each barrel belonging to the second fifty. The reason which makes it necessary for taking so many samples is that the oil varies so much in its consistency—in one case it may be as limpid as oil, in another like treacle, and in a third like melted pitch. The hundred samples are put into one vessel, well mixed, and then a sample taken from the mixture. Even in taking the quantity necessary for analysis from the small sample, it is most important that it is well agitated, as the water existing in the residues is in a mechanical state, and will fall to the bottom; thus, if the sample were poured out without agitation, the percentage would then be given less than the real quantity.

The estimation of the water is conducted as follows:—250 c.c., or a less quantity, are put into a 500-c.c. retort, with a thermometer inserted through the cork. The contents are very gently heated for about two hours in the first part of the operation; when the oil froths, and

threatens to go over into the receiver, the heat must be immediately lowered. After the contents have been kept at a temperature of 100° C. for three or four hours, and the surface of the oil is tranquil, the heat may now be raised to 120° C., and kept at that temperature for several hours till no more water distils over. The flame is never allowed to touch the bottom of the retort; the heat is communicated by means of a rose burner. Water and light oil distil over, which are collected in a graduated tube.

When these residues are submitted to distillation on the large scale, this water distils over, and is condensed in the crude paraffin; this water will vary in the paraffin from 5 to 11 per cent. Here, again, results may widely differ even from the most accurate chemists, simply because the water in the crude paraffin exists in the mechanical state, as will be seen from the following:—

I examined a sample of paraffin which was sent in small and large pieces, and found the water to be 9·09 per cent. As this was thought to be very high, the question was raised, Could it have been a fair sample? To test this, three pieces were taken from the same lot, and a square inch was cut from the centre of each piece, and all the outside surfaces most carefully cut away. These three pieces were then exposed for forty hours to a temperature of 80° C.

No. 1 lost 9·800 per cent
„ 2 „ 8·140 „
„ 3 „ 8·050 „

These three pieces were again heated to the same temperature for thirty hours more, making in all seventy hours.

No. 1 lost 10·100 per cent ⎫
„ 2 „ 8·340 „ ⎬ Mean, 9·876
„ 3 „ 11·190 „ ⎭

When the paraffin which contained only 9·09 per cent of moisture was exposed in a fine state of division to the air, the moisture was reduced to 4·97 per cent. The portion from which the three square inches were cut was chopped up, and left exposed to the air for twenty-four hours; the percentage of moisture was only 4·85, almost agreeing with the first. In a case like this, one analyst might have received his sample in a broken and small state, while the second analyst might have had his in small lumps. We can readily understand from the foregoing there would have been great discrepancy in the results, which would not easily be cleared up without a previous knowledge of the substance.

ON THE

EFFECTS OF MAGNETISATION IN CHANGING THE DIMENSIONS OF IRON AND STEEL BARS,
AND IN
INCREASING THE INTERIOR CAPACITY OF HOLLOW IRON CYLINDERS.*

By ALFRED M. MAYER, Ph.D.,
Professor of Physics in the Stevens Institute of Technology.

PART II.

On the Elongations and Retractions of Rods of Iron and Steel on their Magnetisation and Demagnetisation.

To study and measure with precision the minute elongations and retractions which rods of iron and steel undergo on their magnetisation and demagnetisation, it is necessary that the motions of the part of the measuring apparatus which records these changes in length should not be in the least affected by outside vibrations transmitted to the apparatus, but should be controlled alone by the molecular motions in the rods which take place on changes in their magnetic conditions; also the motions of this indicating part of the apparatus should be synchronous with the

motions in the rods, so that we may be able to study the character as well as the amount of these elongations and retractions.

Several instruments have been devised by me which fulfil these essential conditions, but they were all abandoned (except one to be described in detail in Part IV. of this memoir), and preference given to " The Reflecting Comparator and Pyrometer " of our esteemed colleague, Mr. Joseph Saxton: this simple and precise instrument is well known to American scientists as the apparatus which has greatly aided in giving to the geodetic work of our National Coast Survey its renowned precision, and in rendering accurate the comparisons and constructions of our office of Weights and Measures. A detailed description, with drawings, of this instrument will be found in the " Report on the Construction and Distribution of Weights and Measures, Washington, D.C., 1857," written by Dr. A. D. Bache, the late President of the Academy.†

The Measuring Instrument.

I will now describe the actual adaptation of this instrument to our research. The drawings 1 and 2 give respectively an elevation and plan of the apparatus. A beam of Georgia pine, well seasoned, dried, and then soaked with shellac varnish, formed the base on which the instrument was lined and firmly attached. This beam is 7 feet long, 8¼ inches deep, and 5¾ inches wide. It rested on slips of hard wood at i i, placed at distances from the ends of the beam equal to one-fourth of its length. At a and b are two Vs of brass, which supported the terminal brass caps of the rods experimented on. These rods were all 60·1 inches long, 0·5 inch in diameter; and each rod weighed, on the average, 1520 grms. While the ends of a rod rested in the Vs, 1100 grms. of its weight was supported by the two springs, s s, which took hold of the rod at distances from its ends equal to one-fourth of its length. The flexure of the rod was thus in great part avoided, and it could therefore be accurately centred in the helix, h. This helix is 60·25 inches long, and has an outside diameter of 1·75 inch. It is wrapped on a tube of brass of 0·8 inch internal diameter, slit longitudinally throughout its whole length. At m is the micrometer abutting-screw, against which the end of the rod is firmly pressed by two heliacal springs, which are stretched between hooks on the brass mountings of the screw and a rod which passed through the terminal brass caps of the rod. The brass caps, at both ends of the rod, are terminated by pieces of agate. The other end of the rod is in contact with a slide, c, with triangular section which accurately moves, between guides, in a direction which is the axis of the rod prolonged. To this slide is attached a delicate fusee-chain, which is coiled once around the vertical axis of the mirror, d. This chain is prevented from slipping by a steel pin which securely attaches it to the axis. The slide carrying the chain is firmly pressed against the terminal agate of the rod by means of a heliacal brass spring. Thus the rod is, at one end, firmly pressed against the micrometer screw, while against the other end presses the slide which is connected with the mirror by the intervention of the fusee-chain, which latter is also tightly stretched. The well-joined framework, e, supports the springs, s s, and also a divided circle, f, from whose centre dropped either a fibre of silk, or a filament of glass, which supported a magnet of very hard steel, g. From the oscillations of this magnet, or from its deflections by means of the divided circle and glass filament, were determined the intensities of the residual magnetism of the rods. The deflections of the mirror, caused by the elongations or retractions of the rods, were determined by means of the telescope and the scale, represented at l. The telescope and scale were placed between 5 and 6 metres from the mirror, and the scale was divided into millimetres. Each

† To my friend and colleague, Dr. J. E. Hilgard, of the U.S. Coast Survey Office, I am indebted for the loan of the comparator used in these researches.

unit of the division given in the experiments corresponds to one centimetre of the scale. The above apparatus was placed in a cellar room, without windows and entirely under ground; and the room was always entered by a door, the bottom of which was on a level with the ceiling of the room. During the course of the experiments, the range of variation of temperature of this room did not exceed 0·1° C. in twenty-four hours.

Examination of the Stability and Degree of Precision of the Apparatus.

A rod was accurately centred in the helix, and the micrometer screw and the slide of the mirror were brought in contact with its ends. After the heat imparted to the rod and apparatus by handling had been dissipated, and the scale-reading had remained constant for an hour, I pushed the mirror-slide away from the rod, and then again allowed it to come against its agate terminal. This operation was performed as expeditiously as was consistent with the careful avoidance of shocks to the apparatus. The thermometers, which were placed near various parts of the apparatus, were now read, and it was ascertained that they gave the same readings as before the apparatus was touched. The scale was now read in the telescope, and it was ascertained that the cross threads bisected the same division observed before the slide was moved, thus showing that the mirror returned to the position it had before its rotation. This important fact was repeatedly

the length of the rod; but $\frac{1}{2}$ millimetre, or $\frac{1}{20}$th of a division, could be precisely read in the telescope; I am, therefore, justified in believing that the measures I will give in this memoir can be relied on to the $\frac{1}{200000}$th of an inch.

Determination of the Value of One Division of the Scale in Changes of Length in Inch-Measure of the Rods.

Pasted on the inside of the box in which the mirror, telescope, and micrometer-screw came to me was the following;—"Abutting-screw of field pyrometer. By seven comparisons of 5 turns with 0·1 inch on Troughton scale, in June, 1857, by Mr. Saxton, 1 turn = 0·01912 inch."

As the result of numerous determinations, made on various parts of the screw, I found that $\frac{1}{100}$th of a rotation of the screw equalled 1·737 divisions of the telescope scale, which gives 0·00011 inch as the value of one division of the scale. This value, however, applies only to the experiments on the rods of iron, Nos. 1 to 6 inclusive. Before commencing the experiments on the rods of steel, the distance of the scale from the mirror was changed, and in this new position I found that one division of the scale corresponded to 0·000146 of an inch.

Description of the Helix and Measures of the Resistances of its Wires.

The helix was a compound one, formed of four layers of copper wire. The two inner layers formed 1069 turns of one length of 303 feet of wire 0·087 inch in diameter. The
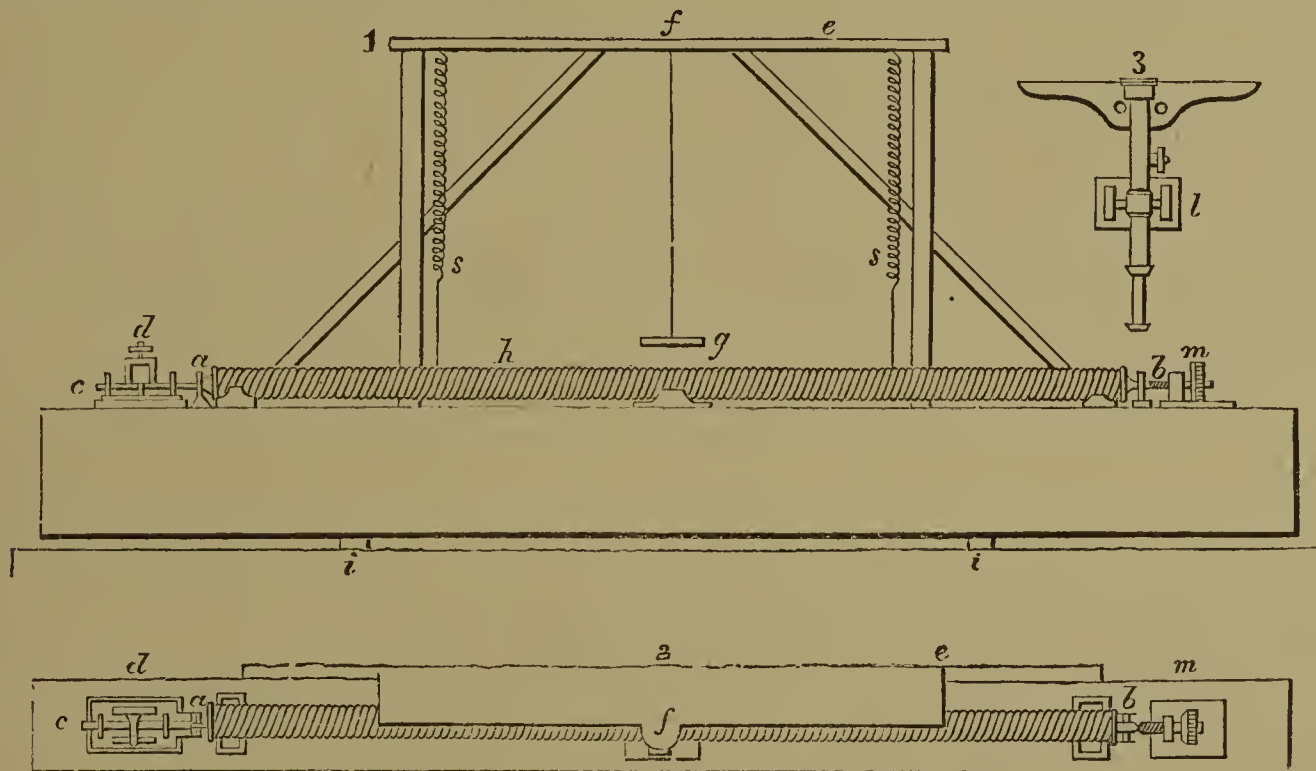
confirmed with all the rods, and at various stages of the research. Indeed, the measures of hundreds of experiments made on the elongations and retractions of rods also confirmed the confidence I obtained in the indications of the apparatus arrived at by the preceding experiments. Jumping on the floor of the room, and the passage of carriages and carts in the streets, had not the slightest effect in disturbing the scale readings.

To ascertain whether the mirror accurately followed the changes in length of the rod, I repeatedly made the following observation:—The readings of the screw-head and the scale were noted; then the screw was rotated by an assistant, so as to push before it the rod. The scale-readings ran up steadily with the rotation, and when the screw was rotated backward the scale-readings ran smoothly down, and when the screw-head had reached the same position it had before it was touched I found that the scale-reading corresponded to that noted when the screw previously had this position. This observation repeatedly made gave me the means of testing the precision of the instrument during the progress of the investigations.

It will be seen below that one division of the scale, or centimetre, corresponded to a change of 0·00011 inch in

two outer layers were formed of another length of 330 feet of 0·112 inch wire wrapped in 850 turns. These two helices could be used separately, or joined into one helix of 633 feet having 1919 turns.

The resistance of the inner helix was 0·44 ohm the outer had a resistance of 0·31 ohm; together giving a resistance of 0·75 ohm. The latter resistance, added to that of the wires leading from the battery through a Gaugain galvanometer to the helix and back to the battery, brought up the resistance to nearly 1 ohm.

A battery of 25 cells of Bunsen was used in the determinations of the coefficients of elongation and retraction; and the above interpolar resistance showed that the maximum effect of magnetisation would be given by connecting the 25 cells, 5 in couple and 5 in series.

Whenever in this research we speak of the effect of 25 cells, it is to be understood that they are connected as just described.

The iron and steel rods used in the experiments were prepared for me with the well-known skill and fidelity of Mr. William Wallace, of Ansonia, Ct. He carefully selected the material, and annealed the iron rods by packing them with iron scales from a rolling mill, in a wrought-iron covered box, and exposing the box to a red

heat for three days; the box was then allowed to cool very slowly. The steel rods were tempered as uniformly as possible throughout their lengths.

Arrangement of the Apparatus, and General Description of the Phenomena which take place on the Magnetisation and Demagnetisation of the Rods of Iron.

The beam supporting the apparatus was so placed that the axis of the helix was in the magnetic meridian. Each rod, before it was introduced into the helix, was tested, as to its magnetic condition, by placing its length at right angles to the magnetic meridian and pointing it toward the centre of a magnetic needle. When the rod, thus directed, gave indications of polarity, its S end was placed downward with the axis of the rod in the line of the dip, and its upper end was struck with a light mallet. The rod was tested, until after one or more operations of this kind it gave no indications of polarity. But on placing the rod in the helix, it of course was again magnetised, but feebly, by the earth's induction. This fact serves to determine the distance at which the magnet, which determined the residual polarity, had to be suspended above the rod. If this magnet is placed too near the rod, an interaction between it and the soft iron of the rod takes place by the inductive action of the magnet, and the vibrations of the latter are more frequent than when it is alone acted on by the earth; but if it be removed to a certain distance above the rod, then the magnetism of the rod acts as a "damper" on the magnet, and its vibrations are slower than when it is only under the earth's influence. There is, therefore, an intermediate position at which the magnet vibrates the same, whether the rod remains under it or is taken away. This distance, of course, varies with the rod used, but on an average it was about 3 inches.

Thus arranged, the rod was allowed to remain until its temperature had become constant, and the scale reading in the telescope was stationary.

The interpolar connections with the battery were made so that the helix, on closing the circuit, would magnetise the rod with the same direction of polarity it already had from the earth's action. The current was now passed from the 25 cells by plunging the amalgamated wire of the open part of the circuit into a cup of mercury; then the scale-reading was immediately noted; the circuit was at once broken, and another reading obtained. The thermometers which were placed on various parts of the apparatus, and which had been read just before closing the circuit, were now again observed, and the room vacated and closed. At intervals of a half hour during the three to six subsequent hours the room was entered, and readings of scale and thermometer obtained.

It may be well to give here a general account of the phenomena which the rods exhibit when the voltaic circuit is successively closed and opened. When the rod has, for the first time, the heliacal current passed around it, a sudden elongation takes place, and this elongation remains steadily of the same amount as long as the circuit is closed and the temperature of the rod remains constant. Now, on breaking the circuit, the rod retracts, with a less velocity than that with which it elongated, but the retraction does not equal the elongation.

The temperature of the rod remaining constant, it has been found that the rod retains the length it attained on the breaking of the circuit; that is, the rod has received, with its permanent magnetic charge, a permanent elongation. On passing the current a second time the rod again elongates, but the elongation is now less than that which took place when the current was first passed around it. On now breaking the circuit, the rod retracts to the length it had before the current was passed for the second time. That is, after the first magnetisation and demagnetisation of the rod, the successive elongations and retractions are equal. These conditions exist until 4 or 5 subsequent make and break circuits have been made; but now a change takes place in the phenomena, for on making the circuit the rod elongates about the same as in the preceding experiments, *but on breaking the circuit* the retraction does not equal the elongation; so that after each experiment the rod is slightly longer than before the preceding experiment was made. Continuing the experiments, the scale gradually passes over the cross-threads, and I have thus repeatedly caused the entire scale to traverse the field of the telescope. On now allowing the rod to remain at the temperature it had when the current was for the first time passed around it, the rod slowly retracts until, after several hours have elapsed, the rod has the length which was observed after the first experiment made upon it.

(To be continued.)

THE PRIESTLEY MEMORIAL.

On Saturday afternoon last the centenary of the discovery of oxygen by Dr. Priestley was celebrated at Birmingham. The admirers of Priestley principally as a scientific discoverer, and in some degree also as a politician and philosopher, some time ago raised a fund which was spent in a marble statue, and by Prof. Huxley this has been presented to the Mayor, as representing the town of Birmingham. The sculptor is Mr. Williamson, of London, a pupil of Foley. The statue is of Sicilian marble, representing the character of the great scientific man with great fidelity. Priestley is shown holding in his hand a burning glass, in the act of discovering oxygen. As Prof. Huxley, in his address afterwards, pointed out, the burning glass is reduced to æsthetic proportions, but the incident chosen by the sculptor otherwise represents accurately the most noteworthy incident of the scientific career of Priestley.

In speaking of Priestley as a chemist, Dr. Huxley said —I may say that I lament, so far as his scientific activity is concerned, that the judgment upon him,—the passing of judgment upon his work,—the forming an estimate of that should not have fallen into better hands than mine, who am no professed chemist, although I hope that the considerations with which we have to deal are all of so simple and elementary a nature that even I, with no pretensions to chemical knowledge, cannot be far astray. I say, to estimate what Priestley did in chemistry, you must carry your minds back to the beginning of the last century, and try—difficult as it is—to form a notion of what was then the condition of chemical science. At that time there was no one who believed, hardly any one who suspected, that the doctrine of the ancients, that air and water and fire are elements, was other than true. The researches, indeed, of Boyle and Hayles had tended to define the qualities of air, had tended to show that there were different kinds of air; but that there was anything like a multiplicity and diversity of elementary bodies, which we now branch under the name of gases, was entirely unsuspected. But immediately at the commencement of the second half of the last century—about the year 1755—a most remarkable man, a young Scotch doctor (Dr. Black), had made investigations upon the nature of what was then called fixed air. He had shown that this substance could be combined with such matters as lime, and such matters as alkali, and could be got again from these combinations; that it was an acid substance, capable of neutralising the strongest alkali, and had then paved the way for the conception of an air-like body, an airiform elastic substance, which, nevertheless, was independent, and could play the character of an independent existence totally distinct from common air. And then a little later, in 1766, Henry Cavendish, one of the most remarkable men who ever adorned the science of this or any other country, in a series of researches which struck one at present by their precision and by their

exactness of statement, showed the nature of sundry other gases, particularly that gas which is called hydrogen now, which was then termed " inflammable air ; " and the special peculiarity of Cavendish was that to the investigation of these questions he applied a rigour of method which was almost unknown before. For he brought the balance into play, and he implied—although he did not express—that great truth which it remained for the French chemist Lavoisier to formulate, the doctrine that " matter is never created and never destroyed." It was following immediately after Cavendish's work that Dr. Priestley commenced his inquiries, and if we look upon them as contributions to our knowledge of chemical fact they are something surprising,—not only surprising in themselves, but still more surprising when we consider that he was a man devoid of the academic training of Dr. Black, that he had not the means and appliances which practically unlimited wealth put at the disposal of Cavendish, but that he had to do what so many Englishmen have done before and since, to supply academic training by mother-wit, to supply apparatus by an ingenuity which could fabricate what he wanted out of washing-tubs and other domestic implements, and then to do as many Englishmen have done before, and many have done since, to scale the walls of science without preparation from the outside. The number of discoveries that he made was something marvellous. I certainly am well within the limit when I say that he trebled the number of gases which were known before his time, that he gave a precision and definition to our knowledge of their general characteristics of which no one before had any idea ; and finally, on the 1st of August, 1774, he made that discovery with which his name is more especially connected—the discovery of the substance which at the present day is known as oxygen gas. There is no doubt whatever, and never has been any doubt, of the great importance of this discovery, which was taken up by other persons, which, no doubt, contributed essentially to the development of those views of Cavendish which led to the discovery of the true composition of water. Nor could there be any doubt that the hints which Priestley gave to Lavoisier, and which I am sorry to say Lavoisier very shabbily ignored, that these hints led to the conceptions of the importance and the functions of these gases which the French chemist subsequently had felt. I repeat, then, there can be no doubt as to the importance of the discovery which Priestley made, and the matter and fact which he discovered ; but it is proper to remark that Priestley's contributions to chemical theory cannot stand upon the same high pedestal as his increase of chemical knowledge. I don't suppose that even from the point of view of chemical knowledge we should be quite justified in putting him by such a giant as Cavendish, but in chemical theory Priestley was certainly unfortunate. He was full of the doctrine then current in his day, that combustion arose from the disengagement of a violent substance of an unknown character, which was called *phlogiston.* It was supposed that this matter was disengaged in combustion, and that air in which a body would no longer burn ought properly to be called dephlogisticated. To the end of his days Priestley remained in this view, and was unable to appreciate the remarkable revolution in chemistry that had been effected by the French chemists. And so, so far from taking what is sometimes ascribed to him, a just view of the composition of the atmosphere itself, you will find that his conception of the atmospheric air was that it was a substance chemically comparable to saltpetre. In Priestley's time the acid contained in saltpetre was called nitrous acid, and Priestley expressly believed that atmospheric air is a combination of nitrous acid and some earthy matter—a speculation than which it is scarcely possible to go further from the truth. But, as Dr. Priestley himself remarks in the course of his own researches, the great thing in science, the first thing is to establish the fact, the second thing is to reason correctly from these facts ; and, no doubt, the services which he has rendered by the establish-

ment of a large contribution to that body of chemical fact, is such that his chemical posterity to all times are not likely to forget.

NOTICES OF BOOKS.

The Chemistry of the Breakfast Table. By F. R. EATON LOWE. Manchester : J. Heywood. London : Simpkin and Marshall.

THIS pamphlet may be characterised as a fair attempt to bring before the general public the latest results of science on the constituents and the action of food. Commencing with the more abstract part of his subject, the author treats of the principal proximate alimentary compounds, such as starch, sugar, the oleaginous substances, and the albumenoids. He next passes in review the various articles of food which ordinarily appear on the breakfast table. Many of his remarks upon bread are well-timed and pertinent. He condemns the " finest white bread " so much in request in modern times as not merely deficient in gluten and in the natural salts of wheat, but as tempting the baker to the use of alum. It is remarkable that not a few of the most dangerous adulterations spring from introducing the idea of colour into our kitchens and our dining-rooms. Alum, the author considers, tends especially to produce constipation. The alum in bread, however, is always accompanied by an excess of the phosphate of potash present in the wheat. Hence we may infer that double decomposition will ensue during digestion, the alumina combining with the phosphoric acid to form the insoluble phosphate of alumina. This then, is, in our opinion, the great objection to the use of alumised bread, that a considerable portion of the phosphoric acid in our food is thus rendered unavailable.

Some of the processes for superseding the use of yeast in the preparation of bread are rapidly glanced at. The aërated bread made under the patent process of Dr. Dauglish is pleasant if taken occasionally, but few persons relish it as a constant article of diet.

In treating of milk the author calls attention to " the peculiar tendency in this secretion to carry off obnoxious matters." " Instances," he adds " are not rare in which poisonous substances taken with the food have passed into the milk, without affecting the cow at all." The lactometer is described, but only to be condemned, as it richly deserves.

The dietetic value of tea and coffee is stated as doubtful. Certain authorities are quoted strongly condemnatory of both. " Tea-dinners " are denounced, and with perfect reason.

In treating of the adulterations of coffee, the author falls into the too common error of " speaking smooth things " about chicory. We defy any one to show that this root has any claims to more lenient treatment than " roasted wheat, beans, or acorns." It imparts, we are told, " a fuller and rougher flavour." The same may be said of sloe leaves added to tea or of extracts of logwood and chestnut introduced into red wines. Mr. Branson, in an able and suggestive paper lately read before the Society of Arts, ascribes the decline in the home coffee trade to the legalisation of chicory. People buy the mixture, find it disagree with them, and instead of condemning the adulterant, eschew coffee altogether. Some of the cheaper kinds of cocoa, the author informs us, contain less than 30 per cent of the genuine nut. Vanilla is stated to be obtained from the *bulbs* of an orchidaceous plant. This is an ill-chosen term, as it will be understood to signify the roots. The vanilla of commerce, or vanelloes, as dealers generally call it, consists of the seed-pods of the plant.

In conclusion the author quotes Dr. Smith's dietary scale, which we cannot in all respects approve. A daily allowance of 78 ozs. of liquids, in a damp and generally cold climate like that of England appears to us excessive.

Syllabus of Materia Medica. By ALEXANDER HARVEY and A. D. DAVIDSON. London: H. K. Lewis.

WERE we a Sultan of the "Arabian Nights" we would cause the "Dedication" to this tiny volume to be written up in letters of gold. As it is, we would claim on its behalf the profound attention of all examiners and of all believers in examinations. "Examinations," say the authors "are such as in a great measure to mar the main intention of the work of education. The examinations involve impossible attainments on the part of students. A burden is laid on them heavier than they can bear. The result is cram-work and failure. They know something of everything, but little thoroughly of anything."

Coming to particulars they tell us that "within four years students have to overtake, and they are presumed to master a large number of subjects,—any one of which might well be the occupation of a life. The sad, the disastrous thing for students, is, that the *range* or *measure* of the pass examinations on every branch is *coextensive* with the whole literature of each. The examinations are indefinite—undefined; they are whatever examiners choose to make them: and examiners are not always discreet. They have their whims, their fancies, their hobbies. *Not seldom they carefully get up the night before* (and from big books on their shelves) for examination purposes on the morrow, what they themselves will forget directly the examinations are over. . . A student may pass with credit at one Board and yet be rejected by another." Sir Robert Christison is reported to have said that nothing is easier than to reject a candidate trained at a different school from that of his examiner. We commend this pithy saying to the attention of those gentlemen who think that our public analysts should all be required to pass at South Kensington. Students have now no time for original thought and research—the only real proof of merit. The examinations, as our authors say, "leave no time for aught save cram-work with the grinder.". . . . "It is sometimes said—and in a boastful way—that the attainments of students in these days greatly exceed those of the students of former days. In a certain sense this is true. But what if these attainments are proportionably shallow—fragmentary, a mere smattering of things?"

From our own observation we can endorse all that Drs. Harvey and Davidson have said, and more. We have known cases of the most paltry caprice—nay of downright and cruel injustice—on the part of examiners. We have known correct answers be received with a stare of contemptuous surprise, in order to unnerve the candidate. We have reason to believe that the qualifications necessary for success are not so much a profound and accurate knowledge of the subjects, as a ready wit, a glib tongue, a confident demeanour, and an acquaintance—obtained by the aid of the grinder—with the whims and the prejudices of the examiner. Now these are the weapons, not of the philosopher, but of the charlatan.

In competitive examinations,—that wonderful nostrum for the intellectual regeneration of our race, which we have imported from China,—all the above mentioned evils are still further intensified.

We conceive that the authors have done good service by denouncing so ably and authoritatively the prevalent system of examinations.

The Chemistry of Fermentation in the Process of Bread-Making. By THOS. KARR CALLARD. London: Elliot Stock.

THIS pamphlet, which has now reached its second edition, is the substance of a lecture delivered at the Bakers' Institute in 1866. The author holds peculiar views. He denies that yeast is a plant, considering the supposed yeast-cells as "simply vesicles of carbonic acid gas entangled in the elastic gluten, which gas naturally assumes the globular form as it passes through liquid denser than itself, and what is termed the growth of yeast is nothing more than the conversion of fresh gluten into its own condition.

In speaking of the use of potatoes as an article used in the manufacture of bread, the author declares—"it is quite a mistake which the public have fallen into in supposing that the use of potatoes in bread-making is an adulteration." Mr. Callard is, on his part, mistaken in supposing that an Act of Parliament, though it legalises an adulteration, can alter its nature. We hold it an adulteration, all Acts of Parliament notwithstanding, because potatoes are commercially cheaper than, and dietetically inferior to, an equal weight of wheat-flour. Nor is the addition necessary. The bread baked in private families in the northern and west midland counties is quite free from potatoes; yet, if less white and crumbly than that sold in London and other large towns, it is sweeter and more palatable.

Another curious position is that flour is the better the less gluten it contains, or, in other words, the less nutritious it is. This view is reached by regarding whiteness as a test of quality. Starch, as we have had occasion elsewhere to remark, is, next to woody fibre, the cheapest product of the vegetable kingdom. In an appendix on the use of alum the author admits that whenever employed, it can only be regarded as an adulteration, and that its regular consumption is injurious. "If the poor," he says, "would be content with a loaf of a darker colour, they could have a wholesome and nutritious bread at a very moderate price."

To mere qualitative testing for alumina in bread or flour as proof of the presence of alum he objects on the ground that cavities in millstones are filled up with a composition of alum and grit, and that the mode of treading out corn by cattle, as practised in Egypt, allows certain particles of clay to become mingled with the grain. Sulphate of alumina, it is further stated, may also occur in salt. Kuhlmann's process, formerly relied upon, he entirely and justly condemns. There are, however, methods well known to chemists by which the amount of alumina present in bread or flour may be accurately determined, and if these are properly applied by competent hands, the trade will have no reason to complain.

CORRESPONDENCE.

DOES SUNSHINE CHECK COMBUSTION?

To the Editor of the Chemical News.

SIR,—One would have fancied that science had long ago put this and kindred superstitions to rest, but, as it appears that two at least of your correspondents still remain in doubt upon this point, you will, perhaps, allow me to offer some remarks in reply to their communications upon the subject. In the first place, I beg to suggest to Mr. Keyworth that if he will take the trouble to ignite some charcoal in a small open chauffer, and place it in the sunshine in a room which can be darkened by shutters, he will find that while exposed to the sun's rays the fire will appear to burn feebly and to be gradually dying out, but if he then close the shutters he will plainly see that combustion is proceeding without any check whatever. The explanation of this is that the superior light force of the sun overwhelms, and, so to speak, drowns, the comparatively feeble light emanating from the incandescent charcoal. No doubt the Pampas Indians have noticed this seeming interference on the sun's part, as mentioned by Mr. Keyworth, but, as we can hardly credit them with a scientific knowledge of the theory of combustion, we may fairly suppose that, because their fires *appear* to die out in the sun's rays, and to revive in the shade, they act accordingly, and furnish artificial shade when it seems to be required.

With regard to Mr. Folkard's far-fetched hypothesis of the sun endeavouring to prevent disorganisation of the

matter its rays had previously been employed in building up, I think I may safely promise him that the sun will not go to the trouble of preventing him from lighting a fire, either of wood, paper, or coal. But I should like to ask Mr. Folkard if he has not forgotten that growing leaves are essential to the decomposition of moist carbonic dioxide by sunlight. Also (as suggested by a friend) whether he has ever tried the experiment of igniting wood or paper by means of the sun's rays with the aid of what is commonly known as a " burning-glass " ?

In conclusion, a few simple experiments would prove to the satisfaction of your correspondents that, whenever carbonaceous matter is brought into contact with oxygen at a high temperature, combustion will proceed in proportion to the oxygen supplied, and that in spite of sunshine.—I am, &c.,

W. F. K. STOCK.

Chemical Laboratory, Darlington,
July 27, 1874.

ON THE CHEMICAL EXAMINATION AND COMPARATIVE COMPOSITION OF SOME SPECIMENS OF PRESERVED MEAT.

To the Editor of the Chemical News.

SIR,—If you will kindly spare me room for these few lines, I think the discussion on the above subject will end here.

Mr. Ogilvie complains that I do not notice his other authorities in substantiation of his notions on fat; I was away from my library, and had no means of reference. I state my opinion because I consider it to be worth as much as that of anyone else, which is " 'the courage of one's opinions ' with a vengeance." I do not see that it is necessary for me to believe all a man says because I quote some of his work.

I never complained of *harsh strictures ;* I said I regretted Mr. Ogilvie should think my strictures were harsh, as I merely wanted to draw forth opinions ; therefore, far from living in a glass house, I rather like people to throw stones. It seems to me that Mr. Ogilvie is so very wrath at having been criticised that he can't get over it, and so accuses me by saying " when he *attempts* to make ' a courteous explanation of errors.' " The judgment of correctness of opinions I leave to your readers.—I am, &c.,

S. W. MOORE.

St. George's Hospital.

THE ESTIMATION OF TANNIN.

To the Editor of the Chemical News.

IR,—On the first glance at Mr. Proctor's letter in your last issue, I hoped my short paper (alluded to by him) had been the means of causing him generously to make public some more perfect method. Judge my surprise on finding that his latest method is merely a slight change from the one I proposed, without being any improvement. His process occupies at least four hours, and for that reason is not better than the ordinary gelatine process. My only object was to obtain a method which would admit of more rapid working than gelatine or rasped hide under ordinary conditions.

My experiments had, so far as I had gone, shown (as I mentioned in my paper) that not only was tannate of gelatine soluble in gelatine with heat, but that the soluble quantity was a *constant* one, if the experiments were made under like conditions. Lack of time has prevented me hitherto from more conclusively demonstrating the truth of this. I may also point out to Mr. Proctor a source of considerable error in his method, viz., some portion of the rasped hide is certainly dissolved out and remains in solution, thus decomposing the permanganate and indicating too little tannin. Permit me to suggest, especially for tanneries, where the titration can be made on a larger scale, a method (also an old one) in use on the Continent which gives good results. The sp. gr. of the

tannin infusion is taken, then a suitable piece of prepared hide (not rasped) is placed in it, and is left in contact with it until the sp. gr. of the solution is found to be constant. As a well graduated hydrometer can be used, these estimations occupy much less time than the permanganate method.

I need not now allude to the discovery by Mr. Proctor of " the new reaction of gallic acid," since, as Professor Flückiger has shown in the *Pharmaceutical Journal* it is to be found in Gmelin's " Handbook " as one of its known distinguishing reactions.—I am, &c.,

C. ESTCOURT, F.C.S.

Borough Laboratory,
8, St. James's Square, Manchester,
August 3, 1874.

THE ADULTERATION OF MILK.

To the Editor of the Chemical News.

SIR,—Your remarks upon the action of the Select Committee upon Adulteration, &c., lead me to say a word upon the analysis of milk.

For eighteen months past I have acted as public analyst to the city of Boston, and it has been my duty to analyse the samples of milk brought to me by the Milk Inspector —a salaried city official—whose duty it is to examine the milk as it arrives here, and bring to the chemist such samples as from lack of density, &c., he suspects. The city formula requires a statement of the sp. gr. the per cent of cream, the total solids, casein, and fat, and sugar and salts. From the percentage of casein + fat is calculated the per cent of added water, considering normal milk to have 7·50 per cent of these two constituents. The former city analyst made 8·3 the standard, but I have used that which was established by Dr. C. F. Chandler of New York. The maximum fine—and one not unfrequently imposed—is £40. It is a noteworthy fact, as establishing the approximate accuracy of the analyses, that twenty-nine milkmen out of thirty pay the fine and do not contest the chemistry work, nor appeal their cases to a higher court.—I am, &c.,

J. M. MERRICK.

59, Broad Street, Boston, U. S.,
July 17, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, No. 24, June 15, 1874.

Solar Theories ; Reply to Certain Recent Criticisms.—M. Faye.—A discussion of the views of Secchi and Ledieu on the origin of solar spots, and on the evidences of cyclonic action in the sun.

Heat Liberated by Chemical Reactions in the Various States of Bodies.—M. Berthelot.—The work accomplished by molecular forces is measured by the amounts of heat absorbed or disengaged during chemical reaction. To define these the author does not think it sufficient to state the nature and relative weights of the reacting bodies. It is needful to know, further, the exact temperature at which the reaction takes place, and the state of aggregation of each body. M. Berthelot examines, from this point of view, the reactions of bodies in the solid, liquid, and gaseous state, and of those in solution.

Electrolysis of Alkaline Carbonates and Bicarbonates.—MM. P. A. Favre and F. Roche.—The authors considered that the use of thermic methods in the study of the alkaline carbonates and bicarbonates might throw new light upon their constitution. The investigations

were directed, in the first place, to the carbonate and bi-carbonate of soda, which were both submitted to electro-lysis. A first series of experiments were undertaken to discover the mode of decomposition of these salts, and a second to ascertain the amounts of heat brought into play during the separation of their constituent elements. In the electrolysis of the neutral carbonate, $C_2Na_2O_6$ is split up at first into $C_2NaO_6 + Na$. The sodium Na then de-composes water, giving off hydrogen, and becoming NaO (a synelectrolytic phenomenon). The residue, C_2NaO_6, may either be supposed to decompose water, reproducing

$$C_2 \frac{Na}{H} O_6$$
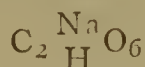
(*synelectrolysis*), or that C_2NaO_6 is decomposed into $C_2NaO_5 + O$; and that $C_2NaO_5 + O$ acting upon water gives rise to bicarbonate of soda (*metaelectrolysis*). Or, setting out from the older view of the composition of car-bonates, we may conceive that in the electrolysis of car-bonate of soda, CO_3Na, it is split up into $Na + CO_3$; the latter being again resolved into O, which escapes, and into CO_2, which converts the neutral carbonate into bi-carbonate. The hydrogen of bicarbonates cannot be considered as basic hydrogen, even although it may be replaced by an alkaline metal so as to form neutral car-bonates.

Phenomena of Static Induction Produced by means of Ruhmkorff's Coil.—M. E. Bichat.—The author finds that if the current of a battery, alternately interrupted and re-established, is made to pass through the thick wire of a Ruhmkorff's coil, two induced currents in contrary directions appear in the fine wire, and for a certain explosive distance there seems to be only one current produced. This current is direct, and the sparks given by it have quite the appearance of sparks of static electricity. Reciprocally, if a series of sparks of static electricity are passed through the fine wire, we receive in the thick wire currents quite analogous to those given by the battery. On examining these currents by means of a voltameter, there appears to be merely one current in an inverse direction.

On Magnetism.—J. M. Gaugain.—In determining the distribution of magnetism by the method of weights sup-ported, we find that friction directed from the arch (of a horse-shoe magnet) towards the poles diminishes the magnetisation near the arch, and increases it near the poles. Friction in the opposite direction produces inverse effects. Hence, considering merely the phenomena of attraction, we may, according to the views of M. Jamin, compare magnetism to a heap of sand, of which the figure may be changed whilst the mass remains invariable. The friction exerted by means of a bar of soft iron sweeps the magnetism either towards the arch or towards the poles. It is, however, difficult to see how this conception can apply to the phenomena of induction.

Fluoxyboric Acid.—M. Basarow.—This paper has been already noticed in the CHEMICAL NEWS.

Absorption of the Ammonia of the Atmosphere by Plants.—Th. Schloesing.—The author experimented upon two tobacco plants exposed to confined, but renewable, artificial atmospheres, prevented from coming in contact with the soil. To one of these atmospheres ammonia was regularly supplied in small known quantities. The plant exposed to this atmosphere was richer in nitrogen than the other in every part. The production of nicotine was not sensibly affected.

Absence of Oxygen in Solution in the Water of Artesian Wells.—M. A. Gerardin.—The water of the sands of Rilly, and of the Soissonnais, was found as free from dissolved oxygen as that of the lower greensand.

Case of Lead-Poisoning.—MM. G. Bergeron and L. L'Hote.—Twenty-six persons in the department Seine-et-Marne were attacked with symptoms which were at first ascribed to bilious typhoid fever, but were subsequently traced to lead-poisoning. The lead was found in the brine used for salting butter, where it was present as chloride. Two of the cases proved fatal. A notable quantity of lead was found in the intestines, the liver, and the brain of the dead.

On Creatin.—M. R. Engel.—The nitrate and ammonia-nitrate of silver are without action upon solutions of creatin. But if into a solution of creatin in excess we pour nitrate of silver, and then a little potassa, we obtain a white pre-cipitate soluble in an excess of potassa. After a short time the liquid becomes a gelatinous transparent mass. If the nitrate of silver is used in excess we obtain merely an olive-coloured precipitate of oxide of silver. The following are the best proportions:—To 2 c.c. of a solution of creatin, saturated in the cold, add 5 or 6 drops of a solu-tion containing one-fifth its weight of nitrate of silver. Then with a glass rod add the potassa, drop by drop, until the precipitate first formed is re-dissolved. The author has also, by an analogous procedure, obtained a compound of creatin with mercuric oxide, corrosive sublimate being used in place of nitrate of silver. The precipitate is white and crystalline, insoluble in excess of potash, and does not blacken under the influence of such excess. On the application of heat, or on long standing, reduction ensues, both with the silver and the mercury com-pound. If we pour corrosive sublimate, drop by drop, into a solution of creatin mixed with an excess of potash we obtain the white precipitate just mentioned, and when all the creatin has been thrown down a yellow colouration of oxide of mercury appears.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Nos. 9 and 10, 1874.

These numbers contain no original chemical matter.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 7, April 27, 1874.

On Phospham.—M. Salzmann.—The author has ex-amined the composition of this body without coming to any satisfactory results. He considers that the body on which he operated is probably a mixture of several phos-phides of nitrogen.

Action of Bromine upon Sodium Ethylate.—E. Sell and M. Salzmann.—It is probable that by the action of bromine upon sodium ethylate the whole series of the brom-substitution products of ethan may be obtained.

Action of Reducing Agents upon Nitro-Benzanilid.—Chichester A. Bell.—By the action of sulphide of am-monium the author obtained a compound corresponding to the formula $C_{13}H_{12}N_2O$.

Derivatives of Sodium Acetic Ether.—W. G. Mix-ter.—The author considers that the results of his experi-ments justify him in assuming that the action of isobutyl-iodide upon sodium acetic ether gives rise to four iso-butyl derivatives, corresponding to the known ethyl compounds.

Bromised Ethers of Acetic Acid.—A. Steiner.—The author attempted to find an easy method of preparing dibromated methan in quantity. He obtained a penta-bromated acetate of ethyl, $C_4H_3Br_5O_2$, which remains liquid even under water, differing in this respect from the corresponding methyl compound. It is readily decom-posed by alcoholic ammonia, yielding dibrom-acetamide, melting at 156°, bromide of ammonium, and a non-crystallisable syrup.

On Dibrom-Methan.—A. Steiner.—This compound consists of—

Carbon	6.9
Hydrogen	1.1
Bromine	91.9
	99.9

Its vapour-density is 85.8 (H = 1). The weight of its volume at 11.5° C. is 2.0844.

Ethereal Oil of Cochlearia Officinalis.—A. W. Hofmann.—The author considers this oil as the mustard-oil of the butyl series, and finds it to contain—

Carbon	52·17
Hydrogen	7·83
Nitrogen	12·17
Sulphur	27·83

or C_5H_9NS. He effected the synthesis of this compound, setting out from methyl-ethyl-carbinol.

Crotonyl Oil of Mustard.—A. W. Hofmann.—The author obtained this compound, which consists of—

Carbon	53·09
Hydrogen	6·19
Nitrogen	12·40
Sulphur	28·32
	100·00

corresponding to the formula C_5H_7NS. In contact with strong aqueous ammonia it quickly forms a well-crystallised sulph-urea, melting at 85°.

Ethereal Oil of Tropæolum Majus.—A. W. Hofmann.—The crude oil is a mixture of various bodies. If submitted to fractionated distillation, the portions passing off first contain sulphur, which is entirely absent in the subsequent portions. The presence of nitrogen was evident. The portion of the oil which boils at 226° (231·9° corrected) is the nitrile of a toluylic acid. It consists of—

Carbon	82·05
Hydrogen	5·98
Nitrogen	11·99
	100·02

corresponding to the formula C_8H_7N. It is identical with the nitrile of α-toluylic acid discovered by Cannizaro on boiling benzyl-chloride with alcoholic potash.

Ethereal Oil of Nasturtium Officinale.—A. W. Hofmann.—On fractionated distillation this oil gave off, at 253·5° (261° correct), a pure substance, which was found to be a nitrile, of the composition C_9H_9N. It appears to be the nitrile of phenyl-propionic acid.

On Methylaniline.—A. W. Hofmann.—Pure monomethylaniline does not react with solutions of chloride of lime, and no aniline is formed on heating its oxalate.

Synthesis of Aromatic Monamines by Alteration of the Position of Atoms in the Molecule.—A. W. Hofmann.—The author examines the change of position of the ethyl and amyl groups.

Lecture Experiments.—A. W. Hofmann.—These relate to the oxidising action of animal charcoal, as shown upon a solution of leukaniline; oxidation of the leuko compound of naphthalin red; liquid phosphide of hydrogen; the maximum density of water; a press for preparing sodium wire; and an inversion of Leidenfrost's experiment to show the behaviour of the alkali metals with water.

Further Observations on the Different Behaviour of Isomeric Nitramines in Contact with Alkalies.—P. Wagner.—The author has examined the behaviour of dinitro-aceto-toluidid and mono-nitro-aceto-toluidid.

Brom-Nitro-Naphthol.—Rud. Biedermann and L. Remmers.—A preliminary notice. The authors obtained brom-nitro-naphthol by boiling brom-mono-nitro-aceto-naphthylamin with concentrated soda lye.

Æthenyl-Diphenyl-Diamin.—Rud. Biedermann.—The author considers that this compound is formed by 2 molecules of aniline and 1 of acetic acid, one of the aniline molecules losing 2H and the other H, which, with the O and OH of the acetic acid, form $2H_2O$.

Æthenyl-Diphenyl-Diamin.—E. Lippmann.—The author has investigated the hydrochlorate and double platinum salts of this base.

Baryta and Barium Peroxide.—C. Rammelsberg.—The author finds that the compound formed by igniting nitrate of baryta is not baryta, but $2BaO + BaO_2$. A stronger ignition expels no more oxygen unless carbonic acid be present. Barium peroxide contains, by calculation, 81·06 Ba and 18·94 O. A preparation containing 78·9 Ba required, in two experiments, so much solution of permanganate that the oxygen thus indicated showed 6·11 and 6·13 per cent. The twofold amount, = 12·22 and 12·26, showed the oxygen present over and above that in BaO. The compound examined was, therefore, not BaO_2, but Ba_3O_7.

Analytical Notes.—C. Rammelsberg.

1. *Determination of Arsenic.*—If ammonio-arseniate of magnesia is dried at 100° to 110°, as commonly recommended, a part of the ammonia escapes. It is best to dry at 120°, and ignite with proper precautions. There is no reduction of arsenic. The volumetric determination of the acids of arsenic—arsenic acid being previously reduced by means of sulphurous acid—by supersaturating with bicarbonate of potash, adding starch paste, and titrating with solution of iodine, is very useful.

2. *Determination of Iodine in Presence of Chlorine.*—In presence of a large amount of chloride of sodium the author has obtained good results by adding sulphate of copper and sulphurous acid.

3. *Decomposition of Certain Metallic Sulphides with Hydrochloric Acid.*—Sulphide of lead, and ores of lead and copper in which it occurs, cannot be dissolved in nitric acid without the deposition of sulphate of lead, which contains, also, antimoniate of lead if antimony is present. The determination of the metals in such cases is easy if the compound is dissolved by boiling in hydrochloric acid. Even ores rich in copper dissolve completely. The hot solution is finally allowed to flow into dilute sulphuric acid, to prevent the deposition of chloride of lead.

Chemical Action of the Solar Spectrum upon the Haloid Salts of Silver.—Herm. Vogel.—A very interesting paper, which would not, however, be intelligible without the accompanying diagram.

Dr. Schultz-Sellack's Corrections.—Herm. Vogel.—A controversial paper referring to *Berichte*, No. 6, p. 386.

Communications from the Greifswald Laboratory.—H. Limpricht.—Ortho-amido-para-sulpho-toluolic acid, and a variety of its salts and derivatives, have been examined by Dr. M. Hayduck.

Constitution of Bone Phosphate.—C. Aeby.—Reserved for full insertion.

Simple Method of Forming Crotonic Acid.—C. Hell and E. Lauber.—Pure mono-bromo-butyric-ethylester, boiling at 170°, is slowly dropped into a warm solution of freshly melted hydrate of potash in absolute alcohol. The fluid becomes spontaneously heated to the boiling-point, while bromide of potassium is plentifully deposited. Carbonic acid is passed into the liquid until the reaction is very feebly alkaline. The portion soluble in alcohol is removed, freed from alcohol by distillation, the saline residue is mixed with dilute sulphuric acid, and the volatile acids are distilled over. The acid distillate, neutralised with soda, is anew decomposed with dilute sulphuric acid, and finally agitated with ether. The residue, after evaporation of the ether, is distilled, and the portion passing over between 175° to 185° is repeatedly subjected to fractionated distillation.

Ostruthin—a New Proximate Vegetable Compound.—E. v. Gorup-Besanez.—This body is free from nitrogen. Its composition is $C_{14}H_{17}O_2$. The author compares its properties with those of the imperatorin of Osann and Wackenroder, and the peucedanin of Schlatter, Bothe, and Erdmann.

Further Communication on the Presence of Leucin and Asparagin during the Germination of Tares.—E. v. Gorup-Besanez.—The author found in the ripe tare

seeds no leucin, and only a small quantity of a body, which, judging from its microscopic crystallisation, may be asparagin.

Composition of the Grease of Wool.—E. Schultze and A. Urich.—Reserved for more extended insertion.

New Formation of Benzkreatin.—P. Griess.—An alcoholic solution of amido-benzoic acid, saturated in the cold, and containing a little ammonia, was mixed with its equivalent of cyanamid, and the solution left to itself at common temperatures for two months.

Preliminary Notice on the Iodides of Thallium.—Th. Knœsel.—The author has obtained three compounds, Tl_2I, a green fusible body, which sublimes readily, forming transparent amorphous masses of a red red colour, which in contact with water become green. The yellow iodide, TlI, sublimes, forming yellow masses. The black compound, TlI_3, yields also yellow masses, and gives off vapours of iodine.

Conversion of β-Benzoyl-Benzoic Acid into Anthrachinon.—Arno Behr and W. A. van Dorp.—A mixture of 2 parts phosphoric acid, and 1 part of β-benzol-benzoic acid was distilled with the addition of sand. The distillate is pure anthrachinon.

Saccharomyces Cerevisiæ and Free Oxygen.—Adolf Mayer.—An interesting paper on the fermentation question, to which we may return by opportunity.

Correction.—H. Salkowski.—The author wishes to modify his " graphic formula " of dinitro-anisic acid.

Reduction of Trichlor-angelactic Acid.—A. Pinner.—The reduction of this acid differs in its results from that of trichloro-lactic acid.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 5, May, 1874.

Report Given by MM. de Luynes and Homberg, on Behalf of the Committee of Economic Arts, on the Preserved Milk of the Anglo-Swiss Company, Page and Co., as Presented by M. Jeoffroy, Representative of the Company in Paris.—This report includes a full account of the Company's operations as carried on at Cham, in the canton Zug, about three leagues from Lucerne. The daily production is at present 8000 boxes, for which the milk of 2000 cows is required. The concentrated milk contains one-third its weight of sugar, and remains sound for a long time after the box is opened, even in the heats of summer. The weight of the milk in each box is 450 grms.

Composition and Analysis of the Concentrated Milk of the Anglo-Swiss Company of Cham.—M. A. Müntz.—The reaction of the milk is feebly alkaline, and its specific gravity is 1·313. Contrary to what has been supposed, a certain quantity of inverted sugar is present. The composition of two samples was—

	No. 1.	No. 2.
Cane-sugar	38·8	29·4
Inverted sugar..	1·7	12·4
Milk-sugar	13·3	13·9
Butter	9·5	8·5
Casein, albumen, and salts ..	11·0	12·0
Water	25·7	23·8
	100·0	100·0

The amount of inverted sugar increases with keeping. The milks employed in the manufacture of these two samples must have had the following composition :—

	No. 1.		No. 2.	
Milk-sugar	5·2	} 13·2 solids.	5·2	} 12·8 solids.
Butter	3·7		3·2	
Casein, &c.	4·3		4·4	
Water	86·8		87·2	
	100·0		100·0	

These samples agree closely in their composition with a normal milk, which may be taken as—

Milk-sugar	5·2	} 13·0
Butter	4·0	
Casein, &c.	3·8	
Water	87·0	
	100·0	

The composition of this milk contrasts very favourably with that generally supplied in Paris, which frequently contains not more than 7 per cent of solids, of which 1·5 to 2 is butter.

Manufacture of Phosphate of Ammonia for the Purification of Saccharine Syrups.—M. Lamy.—This paper has been already noticed in the Chemical News.

Alloys Employed in the Manufacture of Gold Coin.—Eug. Peligot.—This paper treats the subject from an economical rather than a chemical point of view.

Preparation of the Alloys of Iron and Manganese used in the Manufacture of Steel by the Bessemer Process.—Carbon and phosphorus are pronounced mutually exclusive, but either of them yields with iron an alloy possessing the properties of steel. The metallurgic company of Terre-Noire has achieved a result of great importance for the perfectation of the Bessemer and the Martin process, by the introduction of solid blocks of an alloy of iron and manganese, containing 65 per cent of the latter metal, and capable of being introduced into the converter in the last stage of the operation.

Production and Consumption of the Precious Metals During the Period 1857-1871.—M. E. Roswag.—An economical paper of no technological interest.

<center>No. 6, June, 1874.</center>
This number contains no chemical matter.

<center>No. 7, July, 1874.</center>

The Great Chemical Manufactures at the Vienna Exhibition of 1873.—M. Lamy.—The subject matter of this paper is already well known to our readers.

Crystallisation of Glass.—Eug. Peligot.—In clearing out the glass furnace of M. Chagot, at Blanzy, certain crystalline geodes were found, which had been formed during the cooling of the vitreous mass. Their composition is given under No. 1, No. 2 being the transparent glass from which these crystals had separated, and No. 3 the glass in its normal condition :—

	I.	II.	III.
Silica	62·3	61·8	62·5
Lime	22·7	21·5	21·3
Magnesia	8·4	5·4	5·6
Oxide of iron	3·2	3·0	3·0
Alumina	2·5	2·1	2·1
Soda	0·9	6·2	5·5
	100·0	100·0	100·0

Hence it appears that devitrified or crystallised glass has undergone, not a mere physical change of structure, but an alteration in its chemical composition. The increase of magnesia, and the decrease of soda are remarkable. The form of the crystals approaches that of pyroxene; that is, an oblique but nearly right prism.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of gunpowder. Bruno Hoffmark, St. Petersburg. (A communication from Bernard Wiener, Colonel of Artillery, St. Petersburg). November 17, 1873.—No. 3731. This invention consists in the manufacture of gunpowder by what is termed the dry way. Instead of adding a certain quantity of water to the ingredients—saltpetre, sulphur, and charcoal,—as in the ordinary mode of manufacture, after they have been mixed together in the mixing-barrels or tubs, the mixture is submitted in a dry or unwetted state to the action of a press heated by steam to about 250° F. (120° C.).

Improvements in the purification of sewage-water. Major-General Henry Young Darracott Scott, C.B., Ealing, Middlesex. November 18,

1873.—No. 3742. This invention relates to the treatment of sewage-water coloured with dyes, for the purpose of removing the colour therefrom. In applying my invention, I prefer to treat the sewage by the lime method of precipitation, using no more lime than is essential for clarification.

Improvements in the precipitation of sewage- and other foul waters, and in the preparation of precipitating materials. William White, Thurlow Road, Hampstead, Middlesex. November 20, 1873.—No. 3781. In the Provisional Specification of a Patent No. 2532, dated July 24, 1873, it is stated that, in the treatment of sewage- and cesspool-water, milk of lime is introduced to neutralise any excess of acid and to pre-cipitate calcic phosphate, which in some cases is mixed with the sewage- or cesspool-water. Instead of milk of lime simply, this Pro-visional Specification describes the use of lime, charcoal, or phosphatic charcoal.

Improvements in compounds designed for the manufacture of cements or artificial stone, capable also of being used as an artificial fuel. The Reverend Granville Hamilton Forbes, Broughton Rectory, Northamp-ton. November 20, 1873.—No. 3783. My said invention relates to improvements upon former inventions described in the Specifications of Letters Patent, No. 1816, bearing date May 19, 1873, and No. 1832, bearing date May 20, 1873. According to my present invention, I intimately mix the foul or refuse lime of gas-works, or the equivalent thereof, with coal-tar, or peat-tar, or wood-tar, or mineral-tar or pitch, or any similar bituminous substance, or with a combination of any two or more of them, and with chalk or limestone, or any combination of the two, either with or without petroleum or similar hydrocarbon oil, and with or without vegetable or animal oil or fat or fatty matter. I use water to bring about an intimate mixture of the foul lime and the chalk or limestone.

Improvements in the manufacture of artificial stones, which improve-ments are also applicable to the manufacture of various other sub-stances, such as soda and alum, and also to fibres. Thaddeus Hyatt, Gloucester Gardens, Hyde Park, Middlesex. November 20, 1873.—No. 3788. This invention consists in dissolving the elements of the materials to be operated upon in water, and then consolidating them by hydrostatic pressure, and charging them with carbonic acid or other gases or vapours. Electric currents may also be employed in such treatment. The same processes are also applied to the manu-facture of soda, alum, fibres, paper material, felts, &c.

An improved process for preparing ammonia from urine. William Armand Gilbee, patent agent, of the firm of L. de Fontainemoreau and Co., South Street, Finsbury, Middlesex. (A communication from A. W. Wahlenberg, Stockholm). November 21, 1873.—No. 3799. This improved process consists in preparing ammonia from the nitro-genous compounds of urine, speedily and completely, by boiling with alkali or lime.

Improvements in the manufacture of carbonate of soda, and in the treatment of compounds produced therein. Walter Weldon, Abbey Lodge, Merton, Surrey. November 22, 1873.—No. 3805. This inven-tion relates to the manufacture of soda by what is known as the am-monia process. It consists in decomposing by artificial carbonate of magnesia the chloride of ammonium produced in that process, and in treating the resulting chloride of magnesium for the reproduction of carbonate of magnesia, and the obtainment of hydrochloric acid.

Improvements in the preparation of copying-inks. Alfred Vincent Newton, mechanical draughtsman, Chancery Lane, Middlesex. (A communication from Adolphe Teysonnière, Paris). November 22, 1873. —No. 3814. In order to counteract the tendency of ink-powders or pastes to form an insoluble deposit, bi-oxalate of potash or oxalic acid is combined with the compound, which is placed in what are known as inexhaustible inkstands, in which the ink is produced by the simple addition of water.

THE CHEMICAL NEWS.

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THE PUBLIC ANALYSTS,
AND THE
REPORT OF THE ADULTERATION OF FOOD COMMITTEE.

As will be seen from the report of the meeting held at the Cannon Street Hotel on Friday last, the Public Analysts, to a man, utterly rejected the proposal of the Select Parliamentary Committee, that all disputed cases should be referred to the Inland Revenue Laboratory at Somerset House. In addition to the arguments against this scheme, which we have already laid before our readers, it was urged that the award of any referee, however qualified, should be made on oath, and should be liable, like all other evidence, to be tested by cross-examination. Neither the Local Government Board, nor Parliament itself, can invest any chemist with the infallibility which the suggestion of the Select Committee would require.

We feel bound to congratulate the Public Analysts on their good taste and moderation. The contemplated "aggression" was rejected without the introduction of personalities, and without any desire to carry the war into the enemy's country. It is not unreasonable to hope that the number of disputed cases will be, in future, much reduced. The methods for the analysis of articles of food are undergoing great and rapid improvement. The vexed question, "What is an adulteration?" which has occasioned no small diversity of opinion, will receive an approximate solution. But, if referees are needed, there can be no doubt that the selection should be made by the Public Analysts themselves. Let them, we say, have the right of choosing a few men of undisputed standing and of known special experience, and let the services of these be called in if a disputed case should arise.

As little favour was shown to the other proposal, that every candidate for the office of Public Analyst should have passed an examination at South Kensington. Whilst it was fully admitted that the exclusion of unqualified men was essential, it was contended that the proposed scheme would give a monopoly of patronage to one particular institution, or to its head for the time being, which would be grossly unfair to other schools and to the pupils of private analysts, and which would ultimately lead to abuses. A Committee chosen by the Public Analysts themselves would be the most suitable body to test the qualifications of every future candidate. This is, we think, indisputable, and it is in harmony with general precedent. Who, for instance, decides whether a young man is fit to be admitted as a Member of the Pharmaceutical Society, and, as such, to be allowed to compound and dispense medicines? Not a Government department, not some one person holding some particular public appointment; but a body of examiners chosen by the Council of the Pharmaceutical Society. Why, in like manner, should not the Public Analysts, or their Council, appoint examiners to test the fitness of candidates; and why should not the law recognise and uphold their authority, as it does in parallel cases?

This brings us to the most interesting consideration in connection with the late meeting—the professional organisation of analytical chemists. Such an organisation we have long contended for. We hold it necessary for the exclusion of incompetent and dishonourable intruders, for the maintenance of a strict professional etiquette, and for the elevation of the professional status. We see in it the only means to do away with the scandal of "high" and "low" analyses, made respectively to sell by or to buy by. Therefore we rejoice when we see any movement, however slight, in the required direction. Still we do not conceal from ourselves that the Committee appointed by the meeting on Friday last to arrange the preliminaries of the proposed Association have taken in hand a most arduous task. The first step is almost as difficult as was placing the first stone of the dome of St. Peter's. At the very outset the Committee are met by the question, Who is entitled to the membership of the proposed Association? Are they first to examine each other, and then extend the operation to their constituents? Or are they to assume that all who are already in practice are competent, and merely to lay down rules to exclude all unqualified persons for the future? The latter procedure, with all its drawbacks, seems the only practicable measure. It is what was followed in the case of the medical profession. When the modern Acts for regulating the standards of medical education were passed, it was enacted that all persons in practice at that time should be recognised without further enquiry, but that all new candidates should give proof of their satisfactory qualification in manners prescribed. It is difficult to see how the Committee of the proposed Analysts' Association could do better than follow this precedent. When once the Association is formed, incompetence will begin to feel uncomfortable, and will gradually be eliminated.

We notice, however, with regret that the Association proposes confining its operations to the analysts of food. This, we think, is a mistake. It would surely have been better to have invited all analytical and consulting chemists to come in and join the movement. At present the Association will represent, not an entire profession, but merely the fragment of one. In other departments, among metallurgical, agricultural, and tinctorial chemists, there is the same need for organisation, and attempts have been made to supply the want. The broader the basis of the Association, the greater will be its influence with the public, with the press, with the scientific world at home and abroad, and with Government. We must, therefore, suggest to the Committee, who have now begun their labours, to consider whether the union of the whole profession should not be attempted. A "Public Analysts' Association" will be a good thing, both for its members and for the public; but an "Analytical and Consulting Chemist's Association" would be many degrees better. If, however, the latter is not immediately practicable, let us by all means accept the former as an instalment.

We were much pleased with a few remarks made at the meeting on the necessity of the Public Analyst taking up a perfectly neutral position, and not seeking to do the work either of an attorney or an inspector. It would greatly strengthen his position with the public if he were, whenever possible, kept in ignorance of the very name of the tradesman whose wares he is examining. We shall endeavour to return to this subject, to examine further certain of its more prominent features.

ON CHRYSENINE.
By T. L. PHIPSON, Ph.D.

THIS is a solid base which I have extracted from crude chrysene. A certain quantity of chrysene is placed in a deep porcelain dish, and twice its volume or rather more of boiling water is poured upon it so as to render it as fluid as possible. The water is then acidulated with hydrochloric acid and the mixture stirred well together for some time; it is then allowed to cool and the acid liquid separated and filtered. It is a liquid of a bright yellow colour, from which ammonia precipitates the base in an impure state, in the shape of a brick-red precipitate, more or less impregnated with quinoleine and other bases, and smelling strongly of that substance. It is transformed into sulphate and re-precipitated, and this operation repeated once or twice. Finally the concentrated aqueous solution of the sulphate, which is dark orange with a red fluorescence, is exposed to

sunlight for a few weeks, when a certain quantity of dark sediment forms, and the solution loses its red fluorescence.

Ammonia then throws down the chrysenine in a much purer from, as a bright yellow flocculent precipitate, strongly alkaline, having a hot, acrid, pungent taste, like piperine, soluble in alcohol, affected by light, forming a nitro compound with hyponitric acid, &c.

Chrysenine can also be volatilised, and its vapour irritates the eyes and forms dense fumes with vapour of hydrochloric acid. The brilliant yellow colour of crude chrysene is due apparently to a compound of this new basic substance.

I extracted this base in 1872 and have studied it at intervals since that period, but at present I must content myself with making known its existence.

ON THE
EFFECTS OF MAGNETISATION IN CHANGING THE DIMENSIONS OF IRON AND STEEL BARS,
AND IN
INCREASING THE INTERIOR CAPACITY OF HOLLOW IRON CYLINDERS.*

By ALFRED M. MAYER, Ph.D.,
Professor of Physics in the Stevens Institute of Technology.

(Continued from p. 60.)

Heat Developed in the Rod at the Instant of its Demagnetisation.

THE above described experiments show conclusively that the minute elongations which take place on breaking the circuit are due to the heat developed in the rod at the moment of its demagnetisation; for in the preceding experiment the current did not heat the helix sufficiently to cause radiations from it to elongate the rod ; therefore, to obtain the results described above, it is important to ascertain beforehand that when the current has traversed the helix for a time equal to that occupied in the experiments, the rod during this time does not elongate.

If the current is sufficiently intense to heat directly the helix and rod, the above phenomena of heating on demagnetisation nevertheless manifests itself and can readily be disentangled from the combined effects, as will be seen further on.

These interesting results, proving the development of heat on demagnetisation, were obtained a year ago without any knowledge of the recent work of Jamin and Roger, and the measures made directly on the changes in length of the rods tend to confirm the result arrived at by these experimenters.† Recently Cazin (*Comptes Rendus*, t. lxxv., p. 1265) has shown that "the heat thus produced is proportional to the square of the intensity of the magnetism and to the polar distance ;" and Moutier (*Comptes Rendus*, t. lxxv., p. 1620) deduces this result from a thermodynamic theorem established by Clausius, and thus concludes his paper :—" The increase of *vis viva* which the bar experiences from the effect of magnetisation is therefore proportional to the square of the intensity of the magnetism and to the polar distance. The effects of the demagnetisation correspond to an equal loss of *vis viva*, which is the measure of the thermal effect produced, and this effect is the only one which accompanies the demagnetisation."

The fact that an iron bar is heated by successive magnetisations and demagnetisations has been known for a

* Read before the National Academy of Sciences, Cambridge, U.S.
† I have not been able to find the paper containing Jamin and Roger's experiments, either in the *Comptes Rendus* or in the *Ann. de Chim. et de Phys.* I have obtained the information of their results only from the following passage in the paper of M. Cazin (*Comptes Rendus*, t. lxxv., p. 1266) :—"When we pass an intermittent current in the wire of an electro-magnet, the recent experiments of MM. Jamin and Roger have demonstrated in a definite manner that the core is heated." The method by which they discovered this fact s not stated by Cazin.

long time, but only recently have experiments been made which indicate that this heat is produced at the moment of demagnetisation. In a paper " On the Calorific Effects of Magneto-Electricity, and on the Mechanical Value of Heat " (*L. E. and D. Phil. Mag.*, vol. xxiii., 1843), Dr. Joule first showed that heat was developed in an iron bar when it was rotated between the poles of a powerful magnet, and also determined that the heat thus produced was proportional to the square of the inductive force. These experiments will ever be regarded with interest, for they led Joule to the first experimental determination ever made of " the mechanical value of heat."

It may be of interest to present the following account of the experiments made by Van Breda and Grove, taken from Daguin's *Traité de Physique*, 1861, vol. iii., p. 621 :—
" M. Van Breda having enveloped a tube of iron with a helix through which he passed an intermittent current, found a heating of the iron due to the alternative displacement of the molecules,* the heat being shown by the dilatation of the air contained in the tube, which formed a reservoir of an air thermometer. Grove subsequently determined the heating of an armature of soft iron, on passing an intermittent current in the wire of an electro-magnet on which the armature was placed, or in turning near it the poles of a strong electro-magnet. The heating effects were indicated by a thermo-electrical couple. Cobalt and nickel gave similar results, but less marked ; while non-magnetic metals were not heated in the same circumstances. I have made many experiments on a tube of iron weighing 2 cwts. which confirm these results. The experiments will be given in Part III. of this memoir.

I here present two tables of experiments on rod No. 2, of Ulster iron. The successive discussion of these two tables will give to the reader a clear physical conception of the phenomena, and serve to elucidate the account I have above given of the heat developed on demagnetisation.

TABLE I.

No. of Expt.	Scale, circuit open.	Scale, on closing circuit.	Scale, on breaking circuit.	Elongation.	Retraction.
1	37·6	39·2	38·0	1·6	1·2
2	38·0	39·2	38·0	1·2	1·2
3	38·0	39·2	38·0	1·2	1·2
4	38·0	39·2	38·0	1·2	1·2
5	38·0	39·2	38·0	1·2	1·2
6	38·0	39·2	38·1	1·2	1·1
7	38·1	39·3	38·1	1·2	1·2
8	38·2	39·4	38·3	1·2	1·1
9	38·3	39·5	38·4	1·2	1·1
10	38·4	39·55	38·6	1·15	0·95
11	38·6	39·6	38 6	1·0	1·0
12	38·6	40·0	38·85	1·4	1·15
13	38·85	40·1	39·0	1·25	1·1
14	39·0	40·2	39·1	1·2	1·1
15	39·1	40·2	39·2	1·1	1·0
16	39·2	40·3	39·2	1·1	1·1
17	39·2	40·4	39·3	1·2	1·1

In experiment No. 1 we passed the current for the first time around the unmagnetised rod, and observed an elongation of 1·6 divisions of the telescope scale. Immediately after the observation we broke the circuit, which had remained closed about five seconds, and observed a retraction of 1·2 div. ; the rod now remained at a constant temperature for three hours, and the scale-reading remained steady at 38·0 ; thus showing that the rod had received a permanent elongation of 0·4 of a division on receiving its charge of residual magnetism. On repeating the experiment, we find an elongation and retraction of 1·2 divs., which is the quantity the rod retracted on the first break-circuit. Experiments 2 to 5, inclusive, give the same result ; but on the 6th and subsequent break-circuits we observe a retraction of less than

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* The heat observed, however, may not be entirely due to these motions, for the thermal effects may in part be due to the currents induced in the ron on magnetisation and demagnetisation.

1·2, and this effect we attribute to the heat produced in the rod at the instant of its demagnetisation. It is also noteworthy that, from the moment of breaking the circuit in an experiment until the forming of it in the succeeding one, the scale remained immovable. Taking 1·2 divs. as the amount of elongation and retraction due alone to magnetisation and demagnetisation, we can determine the mean amount of elongation at the moment of de-magnetisation, as follows:—The mean elongation in experiments 6 to 17 is 1·18 divs. This is only 0·02 of a div. less than 1·2, and can candidly be attributed to the errors of observation, but the mean retraction of the same experiments is 1·08 div., which is 0·12 of a div. less than 1·2, and gives us the measure of the effect due to the heating of the rod at the moment of its demagnetisation; for, on keeping the rod at the temperature it had during experiments 1 to 5, we found that it gradually retracted until the scale again remained steady at 38·0.

Table II. is here given to show that nearly the same effects of elongation and retraction are observed when the rod is gradually elongating under the effects of heat radiated from the helix, when the latter has passed through it a powerful current.

TABLE II.

No. of Expt.	Scale, circuit open.	Scale, on closing circuit.	Scale, on breaking circuit.	Elonga-tion.	Retrac-tion.
18	51·4	52·8	51·8	1·4	1·0
19	51·8	53·2	52·2	1·4	1·1
20	52·2	53·4	52·4	1·2	1·1
21	52·5	53·8	52·7	1·3	1·1
22	52·8	54·0	52·9	1·2	1·1
23	53·0	54·3	53·2	1·3	1·1
24	53·2	54·5	53·5	1·3	1·0
25	53·5	54·7	53·6	1·2	1·1
26	53·8	55·2	54·2	1·4	1·0
27	54·2	55·4	54·4	1·2	1·0
28	54·4	55·6	54·5	1·2	1·1
29	54·5	55·7	54·7	1·2	1·0
30	54·8	55·8	54·75	1·0	1·05
31	54·8	56·0	55·0	1·2	1·0
32	55·0	56·2	55·2	1·2	1·0
33	55·2	56·3	55·25	1·1	1·05
34	55·25	56·4	55·4	1·15	1·0
35	55·4	56·45	55·5	1·05	0·95

The experiments in this table were made on the same rod used in the experiments in Table I., but before this new series was commenced I passed around the helix a stronger current than previously used, so that the rod was elongated, by the heated helix, from 39·2 divisions of the scale to 51·4 divisions, and while the scale was advancing to this reading I determined its rate of progress, and found it to be 3·6 divs. in ten minutes. Therefore these experiments were made on the rod while it had a slow motion of elongation. The mean of the elongations is 1·22 divs. The mean of the retraction is 1·04 divs., which, subtracted from 1·20, gives 0·16 of a division for the effect of the heat of one demagnetisation. The reduction of Table I. gave 0·12 of a div. for this effect. The difference in the two results I thus account for. While the bar was slowly expanding from the heat radiated from the helix, the cir-cuit was made and the elongation was immediately observed, but about five seconds elapsed before the reading could be made and the circuit broken, and during these five seconds the rod was expanding, but so slowly that its amount could not be read, but was often visible. That this minute expansion could not be determined was to be expected, for if the rod elongated from heat 3·6 divs. in ten minutes, it elongated only 0·03 of a division in five seconds, and 0·03 of a div. was a quantity too small to be measured on the scale, but it nevertheless existed there, and during the continuance of 18 make-circuits would amount to 0·03 × 18 = 0·54 of a division; quite an appre-ciable quantity when we come to calculate the mean with

this fraction contained in the sum of retractions given in the last column of the table. Therefore, to obtain the effect of the heat developed at the moment of demagnetisa-tion, we should subtract 0·03 from 0·16, the heating effect of demagnetisation determined without this correction. This gives 0·16 − 0·03 = 0·13 of a div.; while from Table I. we deduced 0·12 for the value of the same effect. The difference of only 0·01 div. in the two results is not, how-ever, to be taken without some reserve, for in the calcula-tions I assumed that the rod had the same rate of expan-sion under a closed circuit as under an intermittent one, and this I did because I had no means of determining the difference, if any exist. Experiments similar to those just given were made on all the iron rods, and similar results were obtained.

Relations existing between the Number of Break-Circuits, the Heating of the Rod, and its Elongations.

At this stage of the investigation, it became of interest to determine the above relation. For that purpose I drilled a hole 6 inches deep in the direction of the axis of rod No. 3, of Norway iron, and inserted into this hole a thermo-electric couple formed of two wires, one of copper, the other of iron. This compound wire was wrapped, first with two layers of waxed silk, then with twelve layers of floss silk, and over these layers I coiled two more layers of waxed floss silk, leaving, however, the point of junction of the wires exposed.

This apparatus was introduced into the rod so that the uncovered point of the wire was about 1 m.m. from the bottom of the hole, and the space included between the point of the wire and the bottom of the hole was filled, in some experiments with iron filings, in others with mercury. The terminals of the thermo-electric couple were connected with a delicate galvanometer. With the apparatus thus arranged, I successively made 50, 100, 200, 300, and 400 break-circuits, taking care that the closed circuits, preceding the break-circuits, should all be of the same duration.

After each series of break-circuits the elongation pro-duced in the rod and the permanent deflection in the galvanometer-needles were noted, and the observations showed that the elongations and the increments of tem-perature in the rod were proportional to the number of break-circuits.

(To be continued.)

ON THE ESTIMATION OF POTASSIUM.

By ROBERT R. TATLOCK, F.R.S.E.

IN the CHEMICAL NEWS, vol. xxix., p. 280, I observe an article by Messrs. E. F. Teschemacher and J. Denham Smith, in reply to a paper by Mr. E. C. C. Stanford on " Commercial Analyses," which appeared in vol. xxix., pp. 190—193. In this article, under cover of a reply to Mr. Stanford, these gentlemen have thought proper to make an attack on my friend Mr. James Chalmers and myself on account of an improved process for estimating potassium, which we described to the Chemical Section of the Glasgow Philosophical Society some six years ago, and a notice of which appeared in the CHEMICAL NEWS about that time. This notice of our improved method was shortly after its appearance made the subject of a communication by Messrs. Teschemacher and Smith, in which they took it upon themselves to condemn the process as described by us, without having tried it, and without citing a particle of experimental evidence of any kind that there was any imperfection in it, and proceeded to what was evidently the main object of their paper namely, a description of a process of their own. The gist of their arguments was then that because we con-sidered that pure platinum was the " keystone " of an accurate method for estimating potassium, and because

they had found that a sample of ordinary commercial platinum gave them in *some* cases good results, that therefore the use of pure platinum was wrong.

One of the main objects of our original memoir was to show that platinum became impure when often used, at least when it had been frequently recovered by the well-known reduction-by-zinc method. Upon this point our critics had nothing to say, but we shall be glad if they will tell us now whether they consider the process described by us then for recovering the platinum from waste platinum liquors and precipitates, and for estimating potassium, gives, or does not give, accurate results.

I did not think proper at the time to take any notice of their remarks, chiefly on account of the flippant character of these, but partly also on account of the extreme illness of Mr. Chalmers, who shortly thereafter went to Peru, where he has been since ; and I should have treated their renewed attack with the same silence that I did the former one, had it not been that they have misinterpreted my silence on that occasion, and have assumed that I assented to the conclusions at which they arrived.

I cannot again, at least here, enter upon a discussion of the merits of special methods, but, as all methods are valuable solely on account of the results they yield, I shall best illustrate the value of the method described by Messrs. Teschemacher and Smith, as compared with that described by us, by showing what results were obtained by the respective processes in the hands of their respective authors.

In their strictures on our process in the CHEMICAL NEWS (1868), Messrs. Teschemacher and Smith tell us that in one trial their process, in their own hands, gave 98·6 per cent of nitrate of potash in a sample of that substance which they had previously told us contained 99·997 per cent, which is an error, practically, of 1·4 per cent—rather a serious one, all will say. This difference must arise either from a defect in the process or in the chemicals used, or it may be caused by defective manipulation. I should be sorry to attribute it to their process, and they deny that such an error can arise on account of the chemicals employed, but tell us that " accurate results depend on manipulation." I suppose we are to conclude, then, that it was the result of the manipulation ? They inform us that that experiment was carried out with another object—namely, to test whether the commercial platinum affected the estimation of the potassium. Clearly so, but it does not require a chemist to understand that results differing nearly 1½ per cent among themselves were utterly untrustworthy as regards the settling of that point.

So much for what Messrs. Teschemacher and Smith's process didn't do, in their own hands ; and now a word as to what the one recommended by us is capable of doing, and did. That it does not give too low results, our first memoir sufficiently showed, and in corroboration of this I may mention the following case in which it was sufficiently put to the test :—A Continental firm, who are large manufacturers of potash salts, having got a notion that the process followed by us must necessarily give too low results, recently sent to me a sample of muriate of potash, bearing their usual label, for analysis. One estimation was made by our process, and the result obtained namely, 99·95 per cent of chloride of potassium—was duly reported. I had afterwards the satisfaction of knowing that the sample was one of chemically-pure chloride of potassium sent to test our method.

In these circumstances, I beg to assure Messrs. Teschemacher and Smith that I shall continue to use my process —which I employed a dozen years before the notice of it appeared, which I have used constantly since, and which has every prospect of continuing to satisfy the requirements alike of science and of the parties with whom I have to deal in business. It not only gives exact results with pure potassium salts and with German muriates, but with kelp muriates, of which there are several thousand tons made annually in Glasgow alone, and which always contain sulphate of sodium, and also with kelp sulphates of potash, which often contain 20 per cent and upwards of that substance. I am not aware, however, that the last-named products are much known in London.

Thus far I have referred to Messrs. Teschemacher and Smith's remarks only in so far as they concern me. Mr. Stanford is quite able, if he thinks it necessary, to speak for himself. His well-timed timed paper on " Commercial Analyses " will be hailed, I have no doubt, by many chemists and manufacturers throughout the country who desire the existence of a better understanding as to the methods of analysis which should be employed, and who would feign see the differences in the results obtained by different chemists reduced to a minimum. The importance of the question was discussed at a meeting of the Newcastle Chemical Society held for the purpose on the 7th May last, when the following resolution, passed at a previous meeting of the Chemical Section of the Glasgow Philosophical Society, was, I was glad to see, cordially supported :—" That the Chemical Section of the Glasgow Philosophical Society desires to express the opinion that a Sub-Committee of Section B of the British Association should be appointed to enquire into, and report upon, the processes employed in commercial analysis, and more especially in the commercial analysis of superphosphates and potash salts, and on the manner in which the results are stated ; and that the Newcastle Chemical Society be also communicated with, and requested to support this resolution."

There can be no doubt that a move in the right direction has been made by Mr. Stanford, who, by the way, is not a " Glasgow chemist," but a London gentleman, and a manufacturer of potash salts, and therefore not likely to give countenance or support to any method for estimating potassium which would give too low results.

NOTICES OF BOOKS.

Sulphur in Iceland. By C. CARTER BLAKE, D.Sc. London : E. and F. N. Spon.

THAT sulphur is of the utmost importance to chemical manufacturers is a truth so fully recognised that any attempt at its demonstration would be sheer impertinence. The decline, and possible exhaustion, of the Sicilian deposits, joined to the continually increasing demand for this " key to the treasure-house of nature," makes it very natural that fresh sources of supply should be eagerly sought for. Of all localities where sulphur is known to occur, Iceland may claim preëminence, both for its proximity to our shores, and for the exhaustible store which it offers. In that island there are two principal localities, Krisuvik, in the south-west, and Lake Myvatn, in the north-east. The latter is by far the more extensive. We see no reason why both these deposits should not be actively worked. The demand for sulphur is only limited by the supply, and the amount of capital required to carry on operations would be very trifling. It appears, however, that in a paper read before the Society of Arts, Jan. 15, 1873, an attempt was made to magnify the Krisuvik diggings at the expense of Myvatn. In this paper geological speculations of a very questionable character were paraded, and known geographical facts were treated most unceremoniously. In the pamphlet before us these flaws are dealt with in a very outspoken manner. In Iceland the cost of obtaining sulphur in a marketable state is estimated at £3 per ton, as against £5 17s. 4d. in Sicily, and £4 11s. in Spain. In Iceland the beds are superficial, no mining operations being necessary. Hence it appears certain that Iceland sulphur could be offered in the market at a lower figure than that from the Mediterranean, and at the same time yield a larger profit to the importers.

MEETING OF PUBLIC ANALYSTS.

A GENERAL meeting of the Public Analysts of the United Kingdom was held at the City Terminus Hotel, Cannon Street, on Friday, the 7th inst., for the purpose of considering various topics suggested by the Report of the recent Select Committee of the House of Commons on the Adulteration Act, and of forming an Association of Public Analysts for the purposes of mutual assistance and co-operation.

The following gentlemen holding appointments as Public Analysts were present :—Professor Redwood, in the Chair; Mr. A. H. Allen, Dr. Bernays, Dr. A. Dupré, Mr. C. Estcourt, Dr. Hassall, Dr. Stevenson, and Professor Wanklyn, Members of the Committee; Mr. Charles Heisch and Mr. G. W. Wigner, Honorary Secretaries; and Mr. J. C. Bell, Mr. A. W. Blyth, Mr. F. J. Burge, Dr. Corfield, Mr. T. H. Davis, Mr. Thos. Fairley, Dr. Grainshaw, Mr. John Horsley, Mr. Geo. Jarmain, Mr. E. W. T. Jones, Mr. C. H. Piesse, Mr. F. M. Rimington, Mr. G. A. Rogers, Mr. Wentworth L. Scott, Dr. Tripe, Dr Vinen, and Mr. J. Wiggin.

The CHAIRMAN —Gentlemen, the objects of this meeting have been communicated to you by a circular, which I presume you have all seen, and to which I am very glad to find so general and cordial a response afforded by the Public Analysts, because those who attend here but imperfectly represent the whole that communications have been received from. The immediate cause of our meeting has been the report of the Select Committee of the House of Commons in which certain alterations are recommended in the Adulteration Act which appear to us very undesirable, and in which, also, remarks are made concerning Public Analysts which we think call for explanation. But, although these are the causes prompting us to immediate action, there are, irrespective of those circumstances, sufficient reasons to justify our coming together and associating to promote our common interests and to improve the security for the efficient performance of our duties. There are three objects now before us—First, the refutation of unjust imputations; secondly, the repudiation of the proposed measures of interference with our professional position and independence; and, thirdly, the formation of an association having for its objects mutual assistance and co-operation among Public Analysts. These objects will be dealt with in the resolutions submitted to the meeting, and I am very glad to see so many gentlemen here fully able to deal with all that is required to substantiate our position. Much has been said in the evidence given before the Committee, and something in the Report of the Committee, which appears unfair and unjust to our body. A disposition has been manifested to throw all the blame attaching to any imperfections in the carrying out of the Adulteration Act upon the analysts, who have been made a sort of scape-goat for the relief of others. I am not prepared to say that all the analysts appointed under this Act are skilled and experienced chemists; but, if there should be deficiency of qualification in some cases, it appears to me that the blame in great measure rests first with those who have framed the Act, and secondly with those who are carrying it into execution. (Cheers.) That the Act is defective is admitted by all, but one of its defects has been overlooked; I allude to the definition given in the Act of the qualification for an Analytical Chemist. The highest and only real and sound qualification is made subordinate to one which is of little importance. It has been a great mistake to put medical knowledge before chemical knowledge as a qualification—(Hear, hear.) And it is not to be wondered at that parochial and other local authorities should have been misled by the incorrect views thus put before them as to the qualification for analysts. The effect of thus subordinating chemical to medical knowledge has been aggravated by depreciating the value of chemical analysis, a result which necessarily must ensue from the proposal of such a fee as 2s. 6d. for an analysis.

These are fundamental errors which have caused much of the shortcomings complained of. Under existing circumstances, the local authorities, with the imperfect guidance afforded by the Act, have been seeking for analysts possessing all the qualifications indicated, and willing to take the performance of a large amount of work for very little pay. Now I should be glad to see an amended definition of the qualification of analysts under this Act, and some provision made for better and more uniform remuneration. If this were done I feel assured that there would soon be afforded a practical refutation of the statement put forth by Dr. Voelcker with reference to the number of analytical chemists in the Kingdom—(Hear, hear.) But the Report, after indicating that there are no qualified chemists to be found, seems to imply that they are to be produced to order at South Kensington. It is proposed that the authority of the analysts, when certified even in that way, should be superseded by a higher authority at Somerset House. We think it is our duty to consider whether the suggested arrangements are likely to prove beneficial. The Committee who have called this meeting together have drawn up a certain number of resolutions, which will be submitted to you. I have one resolution, which was to have been proposed by a gentleman (Dr. Hassall) who is not able to be here to-day, but who signified his concurrence. I may state that since the circular was issued there has been an addition made to the Committee first of Dr. Hassall's name, and since then of the names of Dr. Bernays, Mr. Estcourt, and Mr. Wanklyn. We propose those gentlemen to be added to the Committee.

The SECRETARY (Mr. G. W. WIGNER)—From the published lists we found the names of seventy-seven Public Analysts. Circulars were sent to every one of them, but, as the addresses of some of them were imperfect, I think it is very likely some six or more which were sent were not received. The number of replies received has been fifty-five, consisting of the resolutions filled up and slightly altered. Of those, all except two express themselves as favourable in almost everything with respect to the scheme.

The CHAIRMAN—Now, gentlemen, I will propose the first resolution, to the effect " That the Analysts present at this conference, having read and carefully considered the Report of the Select Committee of the House of Commons on the Adulteration Act, are of opinion that it is desirable to take this Report into joint consideration, and to suggest amendments in the present Act, with a view to impending legislation next Session." I need say nothing more than I have already addressed to you in support of this resolution.

Mr. ALLEN—I rise, as a matter of form, to second this resolution. We are all so fully agreed on it that I feel sure there is no occasion to amplify on the matter.

Carried unanimously.

Dr. DUPRÉ—The second resolution has been put into my hands—" That the Analysts present consider that the proposed reference of disputed cases to Somerset House Laboratory, or to any body of persons whose decision is to be considered final, cannot for one moment be entertained by professional Analysts, because it would supersede the skilled personal work of an Analyst the result of which had been given on oath by the official work of a department for which no person could be held responsible. They are of opinion that no referee's decision in a disputed case should be accepted as final unless it be given on oath and tested by cross-examination." Gentlemen, there are but very few remarks necessary to be made in support of this resolution. I would say that the proposition to appoint referees proceeds upon the assumption that many of the Analysts' certificates hitherto given have been wrong, and that, in consequence, much hardship has been occasioned. I must entirely dissent from that. I have carefully followed all the published cases, and I must say that, with very few exceptions, I have not come across any case where the Analyst's certificate was materially wrong. I do not believe that the hardship, of which we have heard

so much, has any real foundation in fact. Secondly, that, as the law at present stands, the person against whom the Analyst's certificate has been given has all the remedies he need have. He can have a second analysis made, which, I believe, has only once or twice been refused; and, in case the second analysis is in his favour, the Board which has appointed the Analyst must pay all the costs. Now that is a very good safeguard as it stands. I therefore think it is not at all necessary for a Board of Referees to be appointed. But if it should be thought expedient to have a Board of Referees, it is absolutely essential that their certificate should not be considered final without their presence in Court, and without their giving the Analyst an opportunity of cross-examination. No Analyst who respects himself, who values his reputation, or who takes care in his work, and who does not give his certificate before he is perfectly sure that there has been adulteration, could for a moment submit to have that certificate set aside, by whatever authority it might be, without his having an opportunity of testing, by cross-examination, such a decision.

Mr. WANKLYN—In rising to second this resolution, I have to observe that the proposal to refer to Somerset House as a court of final appeal is to be objected to on this ground, that the authorities in Somerset House have no special knowledge of the work that we have to do, and that many persons who have been appointed as Public Analysts, or at any rate several of them, are more eminent than the people at Somerset House, and to refer to Somerset House would be to refer from higher to lower authorities—(Hear, hear.) With regard to the proposal to have referees at all, there is something to be said for it; but there is only one Court of Reference to which I, for one, should be disposed to submit, and that is to the Public Analysts themselves. As a body, we are more capable of doing this work than any other body in this country; and I will make bold to say that, notwithstanding all that has been alleged against us as a body, we are quite as respectable as the practitioners of medicine or of surgery in this country considered as a body, or as the pharmacists as a body. And there is no Court of Referees which would have any authority, and which would be submitted to, except the general body of Public Analysts.

Mr. SCOTT—I have some little experience which bears upon the proposed reference to Somerset House, and I know something of the way in which they perform their work in that department, and I, for one, should certainly object to any reference being made there in disputed cases. The Board of Referees must emanate solely and simply from our own body, and from no other source, because, although there may not be a very large percentage of our own body, even at the present time, who have given such special and sole attention to the analysis and examination of articles of food and drink which one could wish, still it is a fault that will correct itself day by day and year by year, and in a very few years we shall be obliged, all of us, to turn attention so minutely to this particular subject, and in a manner that no other class of men will, that I contend that, for referees, the Public Analysts as a body are the only persons to supply them from among their own number. I have very great pleasure in supporting this resolution.

The CHAIRMAN—If no other gentleman has any remark to make upon this resolution, I will proceed at once to put it.

Mr. ALLEN—I will simply say, as the originator of the notion in my evidence before the Committee, how thoroughly I endorse all that has been said with respect to the desirability of having a Board of Analysts elected by ourselves from our own number. I think we must agree that there is no one so fit to adjudicate upon such cases as those whom we know. We know who are the best men. We know who are competent, and upon whom we should have personal reliance on their honour and honesty, as well as their scientific skill. And on that account it seems desirable that, if any such Board should

be appointed, it should really be by the Analysts themselves.

The resolution was then carried unanimously.

The SECRETARY said that the next resolution had been altered to the following form:—"That the Analysts present object to a compulsory examination of Public Analysts at South Kensington or elsewhere, as such examination would lead to the exclusion of chemists of experience, whose time is too valuable to be expended in such a manner, and to the appointments falling into the hands of young and inexperienced men; but they at the same time suggest that, if a Public Analyst hereafter appointed is not an analyst who has been for some reasonable time in actual practice, or cannot in any other way prove his ability for the appointment, he should be liable to be called upon to produce proof of having studied for —— years under some competent analyst."

Dr. TRIPE—Mr. Chairman, I have much pleasure in proposing what you have just heard read. I felt that, to attempt to exclude any Analyst who has been appointed, would be an act which would not be recognised by any Government. I therefore proposed an alteration, which has been adopted by the Committee, viz., that the words "hereafter appointed" should be substituted for "newly appointed," inasmuch as the words "newly appointed" would include the whole of the Analysts who had been appointed under the recent Act, because it is a comparatively new measure. If you say that is not a new appointment, you would have to fix what "newly appointed" meant, and therefore, under these circumstances, I thought the words "hereafter appointed" ought to be substituted. I agree with the Chairman that too much stress has been laid upon medical knowledge. I cannot help thinking that, if a public examination takes place at South Kensington or elsewhere, instead of having a large number of young men for one appointment, it might have the contrary effect, and you would have a few men appointed to a large number of vacancies, so that the guarantee of personal supervision of the work becomes less and less. I think that is another very strong reason indeed that this examination should not be insisted upon. I propose the resolution which has been read.

Mr. HEISCH—I have great pleasure in seconding the resolution, with the amendment, if it be the pleasure of this meeting to cut out the words "that he shall produce proof of having passed a chemical examination by some competent examining body."

Dr. TRIPE—That was cut out by the Secretary, and the Secretary did not say the length of time which is proposed here. It is proposed here that it should be two years' work under some competent analyst. I therefore propose the words "two years" to be inserted in the blank, that is in the resolution. I do not think it necessary to read the resolution, it having been read already.

Mr. HEISCH—Under these circumstances, Sir, I but simply second the resolution. We were led to strike out these words by feeling that at the present moment there was no examining body on the subject of analysis that would have our confidence; and if a man has worked in the laboratory under a competent analyst for a reasonable length of time—say two years, if you like—it would be a far better guarantee than any examination which could be conducted in the course of a reasonable time, and which I would say that no gentleman who had anything to do could be expected to give up his time to attend. I have great pleasure in seconding the resolution.

Mr. BELL—I would suggest that, if there is to be an examining body, the referees that are appointed by the Public Analysts should be the examiners in future. Supposing there are five Public Analysts appointed as a Court of referees, those gentlemen should be constituted to examine any future Public Analyst, because we ourselves must know more about food analysis than they do at South Kensington, and therefore we should be better qualified to find out whether a man was fit for his post or not, because, if it is really known that there are men that have

got the appointments now who are not fit to hold it, there is no objection, if they have been newly appointed, to their being removed if they cannot do the work.

The CHAIRMAN—It would be a very onerous thing.

Mr. WANKLYN—There are very strong reasons why we should not call in question the appointments that have hitherto been made, and I should propose to accept them all. If it should happen that persons have been appointed in some instances who are not able to do the work, let them learn to do it. But I think it would be exceedingly bad policy in us if we were to question the appointments that have hitherto been made. We have plenty of precedent of that kind, and those who know the history of the medical profession will recollect what the medical profession has done in similar instances. We should pass resolutions only with regard to future appointments, and I think we should be wise in admitting that. A great variety of proof may be offered that a man can do his work. Let, for instance, his having worked in the laboratory of a competent analyst stand for a proof, and let his having passed a decent examination stand for a proof. It would be very unwise to let South Kensington have any preference over other institutions. We should acknowledge, I think, an examination at King's College, at University College, at the University of Edinburgh, &c. But I think we ought to insist, in future, upon having proof of some kind ; either practical work in a laboratory, or else the passing of a proper examination. I think we should be very unwise were we to question any appointments made hitherto. I believe a few, and only a few, have been improperly made, and I think we can afford to let those appointments stand.

The CHAIRMAN—Well, then, the resolution stands as it is, and I hope you will consider that it has been pretty well discussed. I shall be glad now to take your decision in reference to it.

The resolution was carried unanimously.

The SECRETARY—The next resolution is " That the Analysts present are of opinion that the Report of the Committee is defective, as it does not state what does, and what does not, constitute adulteration, and this omission will increase, rather than diminish, the liability to difference of opinion between Analysts."

Mr. WANKLYN—I rise to move the resolution that has been read. The difficulty in the Act depends upon the definition of adulteration. If the word adulteration were to be received in its literal sense it would not cover the purposes of the Act at all, for the spirit of the Act and the way in which it is being interpreted by the judges is one thing, and the literal interpretation of the Act is another. In order to make this Act work as it is desirable that it should be made to work, and as the judges are evidently endeavouring to make it work, we require to deal with cases in which articles of commerce have been rendered less valuable, not by the putting in of things extraneous, but by leaving something out that they ought to contain ; and clearly taking the word adulteration in its literal sense it does not cover that at all. I propose that we should define the word adulteration ourselves, or rather define a word that should have been in the Act instead of the word adulteration.

The CHAIRMAN—You would not attempt that now, Mr. Wanklyn ?

Mr. WANKLYN—That would be necessary for us to do, and I move that " The Report of the Committee is defective because it has failed to do that which it is imperatively necessary to do."

Mr. ROGERS—I have very much pleasure in seconding this resolution. It appears to me that this is a fundamental defect, and I am strongly of opinion that the omission should be supplied. If it remains unsupplied it will increase the difficulties in the working of the Act very considerably, and I fully agree with the resolution that this omission will increase, rather than diminish, the liability to difference of opinion between analysts. Mr. Wanklyn has touched upon the desirability of providing for the ab-

straction of substances as well as the addition, and I think that that ought to be considered too, and that at some future time we should give a definition of what is, and what is not, an adulteration.

The CHAIRMAN—I may be allowed to state that there will be a resolution further on referring to that particular subject. The Secretaries have received communications from fifty analysts making various suggestions, and it will be proposed to have the subject submitted to a Committee with a view to arriving at some definite proposal.

The resolution was carried unanimously.

The SECRETARY—The next resolution is· " That the Analysts present are of opinion that the facing of tea is essentially an adulteration, and as such to be opposed, but they further think that, if faced green tea is to be allowed at all (as recommended by the Committee), the amended Act should specify a distinct limit as to the percentage of facing to be allowed, since the wording of the Report leaves it open to the analyst to determine what is fairly-faced green tea, and will thereby increase the difference of opinion on certain samples."

Mr. ESTCOURT—The Committee in their Report, under the head of facing, imply colouring as well, I have great pleasure in proposing the resolution that has been read with that change.

Mr. HEISCH—I rise with great pleasure to second this resolution, and I would remark to begin with that I quite agree with those abstractedly who say tea ought not to be faced at all, but I do not think, speaking as a practical man, that we have the slightest chance of carrying that, at least for a good many years, and therefore I concur in this resolution which says " if faced tea is to be sold at all." I put it as a thing that we only admit because it is almost impossible at present to prevent it. With that reservation I have great pleasure in seconding the resolution.

Mr. SCOTT—Perhaps it would be as well, Sir, as I am bound to oppose that resolution almost *in toto*, if I propose an amendment of my own before any remarks are made upon the subject. I am quite of the opinion of both the proposer and seconder in the abstract sense, but I should decidly object to anything like a public confession of weakness on our part like that suggested by Mr. Heisch. I beg to propose an amendment " That in the opinion of the meeting no faced, dyed, or otherwise adulterated, tea should be allowed to be sold after a certain reasonable period has elapsed for the exhaustion of present stocks, as the legalisation of one species of adulteration would probably open the door to other, and more serious malpractices."

Mr. BURGE—I have great pleasure in seconding that amendment.

The CHAIRMAN—Then, gentlemen, I will put the amendment.

There appeared—For the amendment, 9 ; against it, 12.

The CHAIRMAN—The amendment is lost. Then shall I now put the original motion in its original form ? It appears to me that really Mr. Estcourt's modified resolution comes very nearly to what Dr. Dupré has said.

The modification read by the Secretary having been accepted by Mr. Estcourt, the resolution was carried in the following form by 11 to 6:—" That the Analysts present are of opinion that the facing of tea is essentially an adulteration, and as such is to be opposed ; but they are of opinion that, if faced tea is to be allowed at all (as recommended by the Committee), the amended Act should specify a distinct limit as to the percentage of facing to be allowed, since the wording of the Committee's Report leaves it open to the Analysts to determine what is 'fairly-faced green tea,' and will thereby increase the difference of opinion on certain samples."

The SECRETARY then read the following resolution, which was next in order ; he stated that none of the correspondents had expressed any opinion upon it :—" That tea being an article subject to duty, the Analysts now present see no objection to its being examined in bond, in accordance with the recommendation of the Committee."

Dr. STEVENSON—I have great pleasure in proposing this resolution, and I hope that it will be carried without much discussion, to show the public and the House of Commons too that we, as Public Analysts, have no desire to assume any work that can fairly be carried out by any other body. If tea can be subjected to examination before it has passed into the hands of the public and the analysts, a great benefit would be conferred upon the consumers, and much expense would be saved to the country. The analysts would not desire to examine tea if it could be fairly examined elsewhere. At the same time, I must point out that this resolution would not prevent the analyst examining tea, if any adulteration should be practised in this country, if it fell into the hands of the analyst.

Mr. SCOTT—I can second this resolution because the mover of it has made use of almost the very words which I have inserted in my copy—that the examination in bond should form no bar to conviction should the tea afterwards be proved to be adulterated. The object of that is to avoid the case of some grocer or lawyer coming down to the court with a piece of blue paper, and saying "Oh, here is the Government certificate; you cannot go into the case."

The CHAIRMAN—I confess it seems to me unnecessary to make such an addition, but of course it is open to you.

Dr. TRIPE—As a matter of form I will second Dr. Stevenson's resolution.

The resolution was carried unanimously.

The following resolution was then read by the Secretary :—"That, while agreeing with the general recommendation of the Committee that mixtures should be labelled, instead of a mere verbal declaration of the admixture being made, we consider that the approximate percentage of the ingredient under the name of which the mixture is sold should be stated *on the label.*"

Mr. E. W. T. JONES—In proposing this resolution, gentlemen, I do so with very great pleasure, and I think it is of the highest importance that all articles should be distinctly and prominently labelled. There was a case of mine in the country the other day, where there was a serious adulteration of tea. There was no doubt about the adulteration, but the man happened to say "Well, we believe this tea is pure, but be do not guarantee it to be absolutely genuine." The magistrate held that he had declared that that was an adulterated tea; the consequence was that the prosecution fell through. I really do think that all articles sold should be distinctly labelled, and in such a manner as to clearly represent what they are sold for.

Mr. RIMINGTON—I shall be glad to second that resolution. I have inserted the word "prominently" in my copy. That is, that any notice that is put on the label should be prominently placed on the package,—not stuck on one side, or on the back of it, or anything of that sort, but that it should be boldly labelled what it is.

The CHAIRMAN—I will put the resolution, and you will understand that the word "prominently" is inserted before "labelled," and the word "approximately" struck out before "percentage."

Carried unanimously.

A MEMBER—Resolutions 9 and 10 should be postponed until the meaning of "adulteration" has been defined. I understood some time ago that the Committee were going to enter into that question as to what is adulteration. I know that upon these resolutions we should have a lot of speechifying as to what is, and what is not, adulteration, and I humbly submit to the meeting that the meaning of "adulteration" should be settled first.

The resolutions in question were as follows :—

No. 9.—"That there are certain classes of mixtures—for instance, burnt corn and chicory in cocoa, and sulphuric acid in vinegar—which should be expressly prohibited."

No. 10.—"That, while agreeing with the Committee's recommendation to make the sale of skim milk for new milk a punishable offence, we consider it essential that a minimum percentage of "butter fat" should be fixed by the Act in milk sold as new milk, and we suggest 2½ per cent as the minimum, and we further consider that a minimum percentage of "milk solids not fat" in milk should be fixed by the Act, and we suggest 9 per cent as the minimum,—the proportion by weight in each case being calculated in reference to 100 volumes of the milk."

The SECRETARY said that the ninth resolution was addressed simply to the question whether there should be a prohibitory schedule. It did not suggest anything except by way of example.

Dr. TRIPE seconded the proposal to defer resolutions 9 and 10.

Mr. WIGGIN concurred in the proposal to defer resolutions 9 and 10.

Upon a vote being taken, it was unanimously agreed that they stand over for the present.

Resolution No. 11 was read by the Secretary—"That we approve of the recommendation of the Committee that Inspectors should be 'empowered to *take* samples upon tendering full payment.'"

Mr. BLYTH—I beg to propose that resolution with the addition, "That it is desirable that the purchasers of samples should be a uniform body, and that their action in each town and district should be as equal as possible."

Mr. SCOTT—This resolution has been placed in my hands to propose; your observations will come as well if you are the seconder.

Mr. Blyth having assented,

Mr. SCOTT continued—I have very great pleasure in moving the eleventh resolution with the very slight alteration. Perhaps I am peculiarly sensitive as to the great need for a resolution of that character, inasmuch as within six months seven assaults have been made upon one of my inspectors during the progress of his duties in purchasing samples, and a variety of amusing and uncomfortable incidents have occurred. A packet of pepper was dropped on the inspector in one case, and in many cases samples had been lost. In a few instances fines had been inflicted for assaults connected with such acts. If it were made legal, and generally recognised, that inspectors had a right to take samples, either by themselves or by their properly appointed deputy, it would be taken as a matter of course as a legal right, and these assault cases would no longer be heard of. I have very great pleasure in moving the eleventh resolution.

Mr. E. W. T. JONES—I beg to second the resolution.

Mr. BLYTH—Then what I propose would be really an amendment—"That it is desirable that the purchasers of samples should be a uniform body, and that their action in each town and district should be as uniform as possible." I propose this resolution in consequence of what I know in my own counties. I do not know whether the Analysts of the metropolis will bear me out exactly, but I think those who are country Analysts, and do their work in the country, will bear me out. The Act says that the inspectors of samples should be either the inspectors of weights and measures, the inspectors of markets, or the inspectors of nuisances : so that there are three bodies to choose from, and, as a fact, local boards often choose the least capable men of the three. The inspectors of nuisances are often connected with trade. One or two inspectors of nuisances in the county of Devon, who are empowered to buy samples and send them for analysis, are sellers of milk. In counties there should be a uniform body appointed to obtain samples. I myself believe that superintendents of police would be the best. At all events they have been found the best in the county of Somerset. That system works very well indeed there. They are a uniform body, and they are connected with no trade whatever. But I leave that question open. I do not propose that we should suggest that the superintendents of police or anybody should be selected by the Government, but that some uniform body should be selected. I am quite willing that they should be inspectors of weights and measures, or inspectors of markets, or inspectors of nuisances, if they are the same all over the country ; but where the inspectors of samples are derived

from different classes you get a large excess of action in one part of the country, and none in another. In some parts of the county of Devon there is hardly any inspection, while another part is inspected too rigidly.

No one having seconded the amendment, the resolution was carried unanimously.

The next resolution submitted was as follows :—" That the proposal to leave a portion of the sample with the vendor is objectionable, and will at once open the way for fraud, because inspectors are not, as a rule, able to seal and secure a sample in such a way as to render it impossible to tamper with it. We consider that giving the vendor permission either to accompany the inspector to the Analyst or to seal the sample himself, will entirely meet the necessities of the case, and afford the vendor all necessary protection."

Mr. ALLEN—I have great pleasure in moving this resolution. I think we ought to use our very utmost endeavours to prevent ourselves being thrown on the mercies of the inspectors. The men themselves are men of a low class of life, to whom a ten-pound note is a very great object ; and if they are to be allowed to lend their seal for a few minutes to the vendor, the vendor might replace an adulterated article by a genuine. In that way he could upset your case and damage your reputation. We ought to strive our very utmost to prevent a sealed or authenticated sample being left with the vendor. If the vendor doubts the honesty of the inspector he can accompany him to the Analyst and put any seal or mark he likes upon the sample, which the Analyst ought to mention on his certificate ; but on every ground I object to the inspector sealing and leaving an authenticated sample with the vendor.

Mr. BURGE—I have pleasure in seconding this motion. I think it is of very great importance that the sample should be sealed by the Analyst, and I think that can only be done in the way in which it is now, by being sealed in the presence of the Analyst.

Dr. DUPRÉ—I am in favour of the resolution, but I think it would be a pity if we should make it appear as if we doubted our inspectors. I have the most absolute confidence in my inspectors. To pass this resolution on the ground that our inspectors might be bribed I think would be a very great pity—if it were generally known or to become public that we, as Analysts, have that notion.

Mr. BURGE—I beg to say that in seconding the resolution I have no idea of that kind.

Dr. DUPRÉ—But Mr. Allen's remarks will no doubt be published amongst the rest, and it would be a pity if they were to pass without being noticed.

Mr. WIGGIN—If the order of the Act of Parliament were fully carried out it would prevent this.

Mr. SCOTT—I, for one, should regret extremely that anything should go forth from this meeting tending to cast a slur upon any particular inspector, or the body of them.

The CHAIRMAN—It would be a pity if any imputation of that sort went forth.

Mr. ALLEN—I was not speaking on that point at all.

The resolution was then put and carried.

The SECRETARY read the next resolution which appeared on the paper. It was—" That we consider that any mode of delivery of samples to the Analyst, other than a personal delivery, is objectionable." He said that in consequence of opinions which had been expressed the resolution had been struck out.

The next resolution was—" That we maintain that, as Public Analysts, we occupy a perfectly independent position between the trader and consumer, that we have no interest whatever in instituting prosecutions or securing convictions, these proceedings being taken by the local authorities at their own expense, and that our duty is simply to act as analysts, and carry out the duties of the post assigned to us by the Act."

Dr. CORFIELD—I have very great pleasure in proposing this, and I will say only one or two words. We have

quite enough to do without trying to do either the work of solicitors or the work of inspectors. I have seen once or twice on record that Analysts have tried to do the work of solicitors. At any rate, some one or two have even done the work of inspectors. I am very glad I was asked to propose this, as only a few days ago I was the unfortunate recipient, from a person of whom I had never heard in my life, of a more or less insulting letter, in which he assumed that I had originated the proceedings —in fact, that I was acting in a spiteful manner towards the tradesmen in my district.

Mr. RIMINGTON—I have very great pleasure in seconding the resolution. I cannot believe that any gentleman in the capacity of Analyst can have any interest than that of serving the intentions of the Act in protecting the public, and doing justice to all parties concerned. He ought to know nothing at all about the samples, or where they came from. He could not, therefore, entertain any feeling of vindictiveness, or any notion whatever of doing anything that is not strictly right.

Carried unanimously.

The SECRETARY said that resolution No. 15 had been slightly altered from the form in which it stood on the printed draft, an addition having been made. It now read as follows :—" That an association of Public Analysts be formed for the purpose of mutual assistance and co-operation ; and that the original members of the association be the duly appointed Public Analysts who shall enrol themselves at this meeting on or before the end of the current month, or in reply to a circular notifying the decision of this meeting."

Mr. SCOTT—Which would include other analysts besides Public Analysts.

Mr. WANKLYN—I beg to propose this resolution ; and it is hardly requisite that I should make any remarks in proposing it. What I have said already bears on the subject.

Mr. BLYTH—I beg to second it. I think no remarks are required.

Carried unanimously.

The following resolution was then read by the Secretary :—" That after that date all analysts in actual practice shall be eligible for election as members of the Association. Each candidate for election shall be proposed by four members of the Association (two at least of whom should testify to his fitness from personal knowledge), and shall be voted for by ballot."

Mr. E. W. T. JONES—I have great pleasure in proposing that resolution. I do not think we should be at all selfish just because we have been appointed Public Analysts, and exclude many equally scientific men who have been practising as analysts but have not hitherto thought it desirable to take posts as Public Analysts. They may be thoroughly capable of doing so, and may like to be included in the Association.

Dr. TRIPE—I shall be very happy to second that, but at the same time, unless they choose to avail themselves of what they call the month of grace, I do not think they should be *de facto* members of the Association. I think, however, they should be eligible. This resolution states that two members should testify from personal knowledge as to the fitness of a candidate. I think it is absolutely necessary that those who do not accept the month of grace offered to them should produce some testimony of their fitness to make analyses.

Mr. WANKLYN—I think we should pause before we admit people who are not Public Analysts.

The CHAIRMAN—At the present time.

Mr. WANKLYN—It would be prudent to pause, for by making the society very select, and restricting it to Public Analysts, we shall derive a certain element of strength. Afterwards it may be a matter of consideration whether or not we should admit others as honorary members. But I think that we should not admit any persons as ordinary members of the Association unless they are in actual practice as Public Analysts. At any rate, I think we should

be wise to postpone arriving at a conclusion on that subject.

The resolution was carried unanimously.

The next resolution submitted was " That the name of the association be the Society of Practical Analysts."

Mr. ALLEN—I have had that resolution put into my hands to propose. Of course, if we are called the " Society of Practical Analysts," or the " Association of Practical Analysts," that enables us to extend it, if we desire to do so afterwards, to include other analysts in practice. At the same time, it rather expresses that we ourselves are practical analysts. I hope all who will be appointed food analysts are literally able to practise. As far as its name goes, therefore, it is expansive. If we call ourselves simply the " Society of Public Analysts," it would define it perhaps too closely—restrict it too much ; so it has been proposed to adopt the title of the " Society of Practical Analysts."

Mr. HEISCH seconded the resolution.

Mr. WANKLYN—I should much prefer the name which stands in a former resolution, and that the Society should be called the " Association of Public Analysts." There are a great many reasons why we should make this very special.

Mr. SCOTT—I beg to propose that the name of the Society be the " Society of British Analysts," which will not be so exclusive.

Mr. E. W. T. JONES—I beg to second that ; I think that term will be better than the other.

Dr. STEVENSON—I beg to move that the term " Analysts " alone be used, without any adjective before it.

Mr. WANKLYN—I beg to propose that the name should be the " Association of Public Analysts."

Mr. PIESSE—I beg to propose that it be called the " Association of Food Analysts."

The CHAIRMAN—I think that would not do, because the Act takes in medicine as well.

Mr. RIMINGTON—The term adopted in a former resolution is the title given to us by the Act of Parliament. It has the authority of Parliament, and I think it would be better to use it. I do not think that we can mend it.

The CHAIRMAN—" Public Analysts " ?

Mr. RIMINGTON—Yes.

Mr. HEISCH said that the proposer of the resolution, and himself as the seconder, were quite willing to accept Mr. Wanklyn's amendment proposing the term " Public Analysts."

This proposition was then put to the meeting, and carried, with two dissentients.

Moved by Mr. RIMINGTON, seconded by Mr. HEISCH, and resolved—" That the members subscribe 10s. 6d. each to defray preliminary expenses."

Moved by Mr. ROGERS, seconded by Mr. E. W. T. JONES, and resolved—" That the following gentlemen be appointed a Committee (with power to add to their number) :— Messrs. Redwood (Chairman), Allen, Dupré, Heisch, Stevenson, Wigner, Hassall, Wanklyn, Estcourt, and Bernays."

Moved by Mr. BELL, seconded by Mr. BURGE, and resolved—" That the Committee be requested to draw up a series of resolutions to be submitted to the next meeting of the Society."

The next resolution was " That Messrs. Heisch and Wigner be appointed as Honorary Secretaries."

The CHAIRMAN—I am sure, gentlemen, that I can speak personally to the fact that we are greatly indebted to those two gentlemen for having so admirably, as I conceive, up to the present time, conducted all the business relating to this meeting, on the present occasion and on previous occasions.

Mr. BURGE—I have very great pleasure in moving this. It is only necessary to look at the names in order to approve of them.

Mr. ALLEN seconded the motion. He said that he had been connected with Messrs. Heisch and Wigner from the commencement of their work in the organisation of the

Society, and he knew that their labours had been very great. They ought to be thanked for the past, as well as appointed for the future.

Mr. SCOTT supported the resolution, and hoped that it would be looked upon as a spontaneous expression of the approval of this meeting, and not merely as something " cut and dried " beforehand.

Dr. TRIPE moved—" That it be an instruction to the Committee to carefully consider the various replies to questions 1 and 2, and to draw up a definition of adulteration, and, if they consider necessary, a schedule of exceptions, to be submitted to the next meeting."

The motion was seconded by Mr. PIESSE, and carried unanimously.

Mr. WANKLYN—I wish to move a vote of thanks to the Press, for the way in which it has taken up our interest, and especially to the CHEMICAL NEWS and the *Lancet*. The CHEMICAL NEWS has had a series of very well-written articles on the subject, and it would be graceful if we were to pass a vote of thanks to the Editor of the CHEMICAL NEWS and the Editor of the *Lancet*.

Mr. E. W. T. JONES—I have very great pleasure in seconding Mr. Wanklyn's resolution.

Carried unanimously.

Upon the motion of Mr. PIESSE, seconded by Mr. RIMINGTON, a vote of thanks was unanimously accorded to the Chairman.

Mr. BLYTH—I beg to move a vote of thanks from the Public Analysts as a body to the Committee, who have finished their arduous labours, and who have called this meeting, and who have laboured so much for us. They have no benefit from the labour with the exception of our thanks, and I think that we must give them that most heartily.

The motion was seconded by Dr. TRIPE, and carried unanimously.

The CHAIRMAN—Gentlemen, perhaps I may be allowed to speak on behalf of myself and the Committee, and to thank you for your thanks, and to state that it has been really a labour of love with us. It has afforded the whole of us, I am sure, much pleasure to be able to carry out the several views which you have ratified on the present occasion. I must state that it is to the three or four gentlemen around me, more than to myself, that you are indebted for what has been done previously to this meeting. You may depend upon the Committee devoting their best attention to your interests in future.

CORRESPONDENCE.

THE ESTIMATION OF TANNIN.

To the Editor of the Chemical News.

SIR,—I am very sorry that my letter has annoyed Mr. Estcourt, and should not trouble you again but that one or two of his remarks seem to demand correction.

Though Mr. Estcourt is right in saying that absorption by hide-raspings occupies at least four hours, yet it is misleading to compare it with the old gelatin method, since in the former the mixture is simply set to one side to digest with occasional stirring, while the latter requires incessant attention.

Mr. Estcourt is mistaken in supposing solution of the hide-raspings a source of error in the permanganate process, since, as he himself has shown, and as I long ago satisfied myself, gelatin is unaffected by permanganate in presence of indigo, and this is the only soluble substance in properly cleansed hide. Experimentally I found that even when enough became dissolved to make the solution froth, the titration of indigo was unaffected by it. This is not the case, however, with the old sp. gr. method which he mentions, since, especially in old and sour liquors, a variable portion of gelatin becomes dissolved and increases the sp. gr. very perceptibly. But the crowning defect of

the method lies in the fact that, with unrasped hide, it is impossible in any reasonable time, wholely to exhaust the tannin, and, as Mr. Estcourt knows, Hummer's improvement of using rasped hide only partially overcomes the difficulty.

On the whole, I think we are agreed that a good method is still a desideratum; and, whether he or I or some one else discovers it I do not much care so long as I get the use of it.

In conclusion, I thank him for calling my attention to the fact that my little observation as to gallic acid which *he* is pleased to call a "*new*" reaction is noted in Gmelin, which I was not before aware of. I must hope for better luck next time.—I am, &c.,

H. R. PROCTER.

DOES SUNSHINE CHECK COMBUSTION?

To the Editor of the Chemical News.

SIR,—It may be necessary to point out that in raising this question I expressed no opinion, and that, in common probably with most of your readers, I was acquainted with the current explanation given by Mr. Stock, and was aware that some degree of ridicule attaches to an opposite view. Those who think with Mr. Folkard that this explanation is insufficient to account for what is observed, may be interested in knowing that their opinion is shared by a friend of mine, made a Fellow of the Royal Society for his researches on light.—I am, &c.,

G. A. KEYWORTH.

August 10, 1874.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

The preservation of every kind of organic tissue by his discovery of a new antiseptic as powerful as innocuous. Charles Adalbert Hermann Lindemann, M.D., Radnor Street, Hulme, Lancashire. November 27, 1873.—No. 3871. This antiseptic is boric acid and its various compounds. Fresh meat is preserved by injection of a saturated solution of boric acid in cold water, and by the covering over with pounded boric acid. Corpses are preserved by the injection of a saturated solution of boric acid in benzol. The preservation of yarn or woven tissues is obtained by the immersion into a saturated solution of boric acid in magnesium sulphate, or into a size containing the hundredth part of zinc borate. Finally, the contagious and miasmatic diseases are treated by a solution of pure boric acid in water or spirits.

An improved anti-fouling and preservative composition for ships' bottoms and other submerged structures. Heinrich Rahtjen, Basinghall Street, London. November 29, 1873.—No. 3920. The following are the ingredients of this composition, viz.:—Alcohol, wood naphtha, or methylated spirit; shellac; spirit of turpentine; linseed oil; common rosin; galipot; tar spirit; tallow; Venetian red; arsenic; oxide of zinc; oxide of mercury.

An improved process and apparatus for preserving wood. Charles Pierre Newton Weatherby, Southampton Buildings, London. December 3, 1873.—No. 3975. According to this invention, I charge or saturate the pores of the wood to be preserved with a concentrated solution of bisulphide of lime (or baryta), the same being rendered soluble by excess of sulphurous acid gas under pressure or by refrigeration.

An improved process of making bread. Adolphe Beque, baker, Rouen, France. December 4, 1873.—No. 3990. This invention relates to the use of sea-water in the making of bread, and consists—(1). In the preparation of the sea-water. (2). In the preparation of the leaven. (3). In the regulation of the relative proportions of sea-water, leaven, and flour, those given being, for every 100 lbs. of bread—Leaven, 40 lbs.; sea-water, 27 lbs. 12 ozs.; and flour, 32 lbs. 4 ozs. = 100 lbs. (4). In the mixing of the leaven with the sea-water, and of this combination with the flour. This bread is not only intended for general consumption, but is particularly recommended to asthmatic or consumptive persons, and those suffering from diabetes; it is also stated to be a great preservative agent against epidemic diseases.

Improvements in the manufacture of artificial manure, and in utilising residual products of the said manufacture, parts of which improvements are also applicable to the manufacture of artificial bone. James Henry Staples Wildsmith, manufacturing chemist, Birmingham. December 5, 1873.—No. 4007. This invention consists in making a manure, having the same composition as ordinary bone, by placing apatite, coprolite, or other mineral phosphate of lime (in powder or small lumps), and a little water, in a closed vat, and conducting into the closed vat hydrochloric acid gas so as to dissolve the phosphate. A strong solution of gelatine is added, and the phosphate of lime is next precipitated by ammoniacal gas, and the phosphate of lime, which

takes down with it the gelatine, is separated from the solution of muriate of ammonia by filtration. The phosphate of lime, combined with gelatinous matter, is a manure of excellent quality, and for special purposes may be mixed with sulphated, urinary, excrementitious, or other nitrogenous matters. The residual products of the manufacture, namely, salt-cake and solution of muriate of ammonia, may be converted, the former into carbonate of ammonia, and the latter into solid muriate of ammonia. The precipitated phosphate of lime and gelatine may be solidified and pressed or shaped in moulds, or shaped by carving, filing, or otherwise, so as to produce a variety of useful articles.

Improvements in the manufacture of nitrogen and its application to the production of ammonia, prussiates of potash and soda, and carbonate or caustic potash or soda, and in the manufacture and application of oxygen to the production of sulphuric acid and chlorine, Hartley Kenyon, of the firm of Kenyon Brothers, manufacturing chemists, and Israel Swindells, analytical chemist, Warrington, Lancaster. December 5, 1873.—No. 4013. The features of novelty in this invention consist in producing nitrogen by passing dried air over oxide of barium previously heated in a retort; and, after purifying such gas, we force it through red-hot charcoal and condense ammonia, we pass it into the presence of potash or caustic soda highly heated along with carbon and iron-borings or other metallic oxide in order to produce prussiate of potash and prussiate of soda, or we use the ammonia in decomposing chlorides of soda or potash in the production of carbonate or caustic potash or soda. The oxygen given off from the retorts we pass into chambers or kilns containing sulphur, so forming anhydrous sulphuric acid, and, if hydrated, we blow in steam and condense the sulphuric acid, or we pass the dry acid in a red-hot state along with oxygen through heated spaces into a red-hot cupola containing dried salt, and liberate impure chlorine, which we afterwards purify as described.

SUPPLEMENT

TO

THE CHEMICAL NEWS.

Vol. XXX. No. 768.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note. All degrees of temperature are Centigrade, unless otherwi.e expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, No. 25, June 22, 1874.

Researches on Solution.—M. Berthelot.—It is generally held that the solution of salts in water is attended by the absorption of heat, the phenomenon being likened to the fusion of solid bodies. The result is effected progressively in cases of solution, the heat absorbed increasing with the dilution, in proportion as the amount of water is more considerable. This is the case with the saline hydrates, and most of the anhydrous salts formed by the alkalies, by oxide of lead, and oxide of silver, if we operate at ordinary temperatures. Nevertheless, the fact of the absorption of heat during the solution of salts is far from being as general as is assumed. The number of anhydrous salts which disengage heat in dissolving, and that in a proportion often increasing with the mass of the water, is, perhaps, even larger than the number of salts which dissolve conformably to the supposed normal law. Such are the anhydrous salts formed by the alkaline earths, the earths proper, and the metallic oxides, the alkaline carbonates, almost all the anhydrous acetates, &c. It might seem at first sight that salts might thus be divided into two great classes. But there are good reasons for believing that the distinction is accidental,—at least for the anhydrous salts—and due to the conditions of temperature under which the anhydrous salts are commonly studied. This view the author seeks to establish.

Theory of the Collision of Bodies, regard being had to Atomic Vibrations.—M. A. Ledieu.—This paper consists of observations on the recent communications of MM. Resal and Darboux on the collision of bodies; on the general relation between the amounts of motion gained or lost by every body which receives a shock, and the impulses due to the molecular actions producing the shock, and on the case where only the molecular tangential actions manifested in the shock are introduced in the foregoing relation.

Bitter Lakes of the Isthmus of Suez.—F. de Lesseps.—A historical and topographical paper.

Analytical Examination of Twenty-one Samples of Salt Water from the Suez Canal.—M. Durand-Claye.—Only the chlorine, sulphuric acid, and magnesia have been determined, the results being given in a tabular form.

Employment of Phenic Acid for the Preparation of Timber.—M. Boucherie.—The author thinks the sparing solubility of phenol in water, and the costliness of its solvents, are objections to its use, except along with the sulphate of copper.

Friction in the Shock of Bodies.—G. Darboux.—An addition to the author's paper of June 8, 1874.

Action of Heat on the Isomeric Carbides of Anthracen and their Hydrides.—P. Barbier.—The three carbides known of the formula $C_{28}H_{10}$ are anthracen, phenanthren, and tolan. The author examines the action of heat upon dibenzyl, stilben, and tolan.

Chloro-Bromides of Propylen; Normal Propyl-Glycol.—E. Reboul.—The chloro-bromides examined are—the normal compound, $CH_2Br - CH_2 - CH_2Cl$; $CH_3 - CClBr - CH_3$; $CH_3CH_2CHClBr$.

Bulletin de la Societe Chimique de Paris, tome xxi., No. 10, May 20, 1874.

Determination of Quinine in Cinchonas.—M. Perret.—The author takes 10 grms. of the bark in powder, and boils with 50 grms. alcohol at 90 per cent, mixed with 5 grms. of a lye of silicate of soda, very alkaline and caustic, and marking 40° B. After boiling for three minutes he filters, and extracts the residue again with 30 grms. alcohol and 2·5 grms. silicate, and, finally, with 20 grms. of alcohol. The filtrates are mixed together, evaporated to the consistence of honey, and then extracted successively with 30, 20, and 10 grms. of ether at 65°. The ethereal solution is evaporated to dryness, and the residue acidulated with dilute sulphuric acid. The sulphate of quinine dissolves, and may be precipitated either in the free state, or as an oxalate by oxalate of ammonia. The operation consumes three hours, and the quinine obtained contains mere traces of quinidine and cinchonine.

Pyrogallol in Presence of Salts of Iron.—E. Jacquemin.—In presence of organic ferric salts pyrogallol no longer behaves as with the mineral ferric salts, but forms a blue soluble in water, and remaining stable for some days. Ferric, and perchloride, and sulphate, if treated with a slight excess of an alkaline or earthy alkaline organic salt, acquire also this property of giving a permanent blue with pyrogallol. There is no difference between the action of pure acetate of protoxide of iron and that of the corresponding sulphate (copperas). Ferric acetate, however, whether prepared directly or by double decomposition, gives instantaneously, with a solution of pyrogallol, a fine blue with a slight violet shade. Ammonia turns this colour to a violet, and then to a red. Acetic acid, not in excess, restores the blue. This pyrogallo-acetate of iron changes very slowly. It is only after some days that an insoluble black colour begins to appear. A boiling temperature causes immediate precipitation, and the formation of a blue-black deposit insoluble in alcohol. It is known that ferric acetate prepared with sulphate of iron and acetate of lead, if exposed for some hours to the heat of the water-bath, loses the property of forming Prussian blue with yellow prussiate. The same compound no longer possesses the property of turning blue with pyrogallol. The action of ammonia on chloro-pyrogallate of iron is so sensitive that by its means we may, with 1 grm. of perchloride of iron, colour two hectolitres of water a distinct reddish purple. Every substance which turns the reddish brown of the chloro-pyrogallate of iron to a blue, a violet, or a reddish purple may be classed among alkaline or alkaloidal bodies. We have thus a simple means of distinguishing the alkaloids from the glucosides. To prepare this reagent care must be taken to add but little of the ferric chloride to pyrogallol, since a slight excess of the latter is not injurious. An alcoholic solution may be employed if the substance under examination is insoluble in water. Alkaloids, even in a solid state, turn blue in contact with the chloro-pyrogallate of iron, whilst glucosides undergo no change of colour. Aniline, as is well known, does not restore the blue colour of solution of litmus reddened by an acid: but if we add a drop to the dilute aqueous solution of the chloro-pyrogallate of iron, and shake the mixture for a few seconds, we obtain a fine blue colour. Nevertheless, as long as a substance is not quite pure, as long as we are not quite sure of the absence of every trace of an organic salt, whether ammoniacal, alkaline, or alkaline earthy, we can draw no conclusion from the appearance of a blue colour, since the chloro-pyrogallate of iron is turned blue by the action of acetate of soda, tartrate of ammonia, and even of gum-arabic, or gummate of lime. From the author's experiments on the sucrate and glucosate of lime, he concludes

that these bodies are not salt in the common acceptation of the word, but compounds analogous to the alkaline hydrates. From the action of pyrogallol we may learn whether any given substance really fulfils the functions of an acid, and if, consequently, its neutral compounds with bases may be ranked in the class of salts. On the other hand, the property of the reddish brown pyrogallo-ferric liquors of changing and giving a black precipitate of tanno-melanate of iron ; that of the ferro-potassic tartrate and ferric acetate blues, which leads to the same result, either slowly, or instantly on boiling, suggests the idea of an application to dyeing and calico-printing. In dyeing, the pieces or yarns must be kept moist, so as to produce insolubility and fix the colour. In case of printing it will be found advantageous to cause the pyrogallol to act upon a mixture of acetate of soda and iron mordant, free from excess of acid, thicken, print, and steam. The black is not a good shade, but may serve as a base for compound colours in steam styles.

Part Played by Salts in the Action of Drinking-Waters upon Lead.—M. Fordos.—A detailed account of the action of certain salts in retarding or promoting the action of water upon metallic lead. The salts examined were sulphate of soda, chloride of sodium, chloride of ammonium, nitrate of ammonia, sulphate of lime in saturated solution, saturated solution of sulphate of lime mixed with common salt, and sulphate of magnesia. In all these cases the lead was attacked, and small quantities of it were found in solution.

Extraction of Boracic Acid from Bromatro-Calcite. —This mineral contains—

Boracic acid	42
Soda	8
Lime	13
Water..	37
	100

It is found in several districts of the state of Nevada. To extract the boracic acid the mineral is evaporated with sulphuric acid in leaden pans to the consistence of a thick paste, which is then run out, and which hardens as it cools. It is then placed in cast-iron cylinders, which are heated to redness, whilst a current of steam passes through. The boracic acid is volatilised with the steam, and condenses in chambers lined with lead. To remove the sulphuric acid the vapours pass at first through a layer of coke, arranged in the upper part of the cylinders, which educes the sulphuric acid to sulphurous.

Improvement of Old Zinc White.—M. A. Speidel. -If kept for a long time zinc-white becomes granular and gritty, and useless for painting. It may be restored by ignition in an earthen crucible.

Patera's Mercurial Furnace.—M. Kustel.—This is, in principle, a muffle furnace. The ore must be previously pulverised ; but the expense of this operation is unimportant if compared with the improved yield of metal. In the retort process, as used at Idria, a loss of 37 per cent of mercury is admitted, but if the yield is compared with the actual composition of the ore, the loss will be found greater by 12 per cent. Patera considers that his process yields 84 per cent of the mercury present in the ore. The author has examined the residues, and found them completely free from mercury. The temperature in the experiment was kept all along below redness.

Action of Mineral Acids upon Sugar in Presence of the Organic Salts Contained in the Juice of Beet-Root.—M. E. Feltz.—The author found in his experiments the inversion of sugar less considerable than he had been led to expect.

Determination of Grape-Sugar in Beet-Root.—M. G. Krause.—Independently of cane-sugar beet-root contains grape-sugar to the extent of about 0·1 per cent. In spring, when the root has remained underground during the winter, the proportion may rise to 0·3 or 0·4 per cent.

A moist season is favourable to its production. To determine the amount, 100 c.c. of beet-root juice are shaken up with 10 c.c. of basic acetate of lead. The mixture is filtered, washed, and the mixed filtrate and washings freed from excess of oxide of lead by carbonic acid. An excess of this gas must be avoided to obviate even the slightest acidity of the liquid. The neutral acetate of lead present is then thrown down with carbonate of soda, and the liquid is boiled for a quarter of an hour to coagulate the albumen. It is filtered, heated to 100°, and mixed with Fehling's test in slight excess. After digestion for one hour in the water-bath, the suboxide of copper formed is collected, and converted into cupric oxide by ignition in contact with air. The weight of this oxide, multiplied by the factor 0·4534, gives the weight of glucose present in the juice. It is necessary to operate rapidly, and carefully avoid acidity in the liquid.

Determination of the Yield of Crude Sugar.—M. Scheibler.—To value a sample of crude sugar, the author treats it with alcohol mixed with acetic acid, and already saturated with sugar. The apparatus consists of two flat-bottomed flasks. The first, of 50 c.c. capacity, has a stopper cut sloping to admit of the circulation of air. It is perforated with two holes, through which pass a short tube designed for the introduction of the exhaustion liquids, and a tube reaching to the bottom, and widened at its lower end, over which is stretched a piece of flannel to serve as a filter. This filter-tube is externally connected with the second flask by means of a caoutchouc tube. The latter, 100 c.c. in capacity, is fitted with a tube for connecting with the former flask, and another tube, short, and fitted externally with a caoutchouc tube and a pinch-cock. This flask serves as an aspirator when a partial vacuum is made in it. A weighed quantity of the sugar under examination is placed in the first flask, and successively exhausted with the following liquids :—(1) Alcohol at 85 per cent, containing 50 c.c. of acetic acid per litre, and saturated with pure sugar ; (2) alcohol at 92 per cent ; (3) alcohol at 96 per cent, both saturated with sugar. These three liquids are kept in bottles along with an excess of sugar-candy. Finally, the sugar is washed with a few drops of absolute alcohol, then dissolved in water, and examined with the saccharimeter.

Utilisation of Waste Soap-Lyes and Oily Liquors. —M. H. Vohl.—Instead of separating the fatty matters from the water by means of mineral acids, the author proposes to treat them with salts of magnesia. Magnesian soaps are thus formed, containing 60 per cent of fatty matter, and which may be used in the manufacture of gas for lighting purposes.

Contribution to the Theory of Bleaching.—P. de Wilde.—The material, suitably divided, is boiled with water, taken out, allowed to drain, and then exposed to the action of gaseous chlorine. After some time it is boiled in water. If sprinkled with water containing caustic soda, equal in quantity to the tenth of the original weight of the material, it softens, and is then easily and finally bleached with chloride of lime at 1° B. The bleached fibre has a silky lustre.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 8, May 11, 1874.

Coniferin and its Conversion into the Aromatic Principle of Vanilla.—Ferd. Tiemann and W. Haarmann.—The authors commence with describing the preparation of coniferin, the juice scraped from recently felled and barked pine trees in spring-time being the raw material. It is then split up by digestion at a gentle heat with a small quantity of emulsion. The vanillin thus obtained is at first inodorous, but in course of time acquires a faint odour of vanilla. Coniferin, $C_{16}H_{22}O_8$, furnishes the following series of products :—$C_{10}H_{12}O_3$ (grape-sugar, $C_6H_{12}O_6$) ; vanillin, $C_8H_8O_3$; protocatechuic acid, $C_7H_6O_4$; pyrocatechin, $C_6H_6O_2$.

On Hydrargyramids.—A. Oppenheim and S. Pfaff.—The authors obtained a phenylated hydrargyracetamid $(C_2H_3ONC_6H_5)_2Hg$, which crystallises from alcohol in small colourless needles, melting at 215° with partial decomposition.

Contributions to the History of the Terpenes.—A. Oppenheim and S. Pfaff.—The authors endeavoured to throw light upon the constitution of the terpenes—hydrocarbons of the formula $C_{10}H_{16}$—by converting them into cymols, $C_{10}H_{14}$, and determining the nature of the latter by the study of their oxidation-products, They report on the results obtained with tereben, bornsen, geranien, and eucalypten.

Compounds Connected with "Stenhouse's Substance," Urethan Derivatives.—C. Bischoff.—The author examines the action of acetal, mono-chlor-acetal, chloral, bromal, croton-chloral, valeraldehyd, mono-chlor-valeral, and oil of bitter almonds upon urethan.

On Oxæthen-Toluydin.—Eugene Demole.—The author describes the preparation and properties of this compound, $C_9H_{13}NO$; its double platinum-chloride, oxalate, and acid sulphate; its behaviour with CH_3I when methyl-oxæthen-toluydin is obtained; the double platinum-chloride of the latter, and its behaviour with CH_3I; and the formation of the double chlorides of platinum and of gold with dimethyl-tolyl-oxæthen-ammonium-chloride. He further describes dioxæthen-toluydin, and the products obtained by the dehydration of oxæthen-toluydin.

New Method for the Expeditious Preparation of Glycol.—Eugene Demole.—102 parts of dry acetate of potash, 195 of æthylen bromide, and 200 of alcohol at 80 per cent, are heated to a boil for sixteen to eighteen hours in a flask provided with a cohobator. The liquid is filtered from the bromide of potassium and distilled, first in the water-bath, and then in the oil-bath.

Communications from the Laboratory at Greifswald.—H. Limpricht.—These communications relate to a new nitro-toluydin, and to benzol-nitro-toluydin.

Ammonia-Soda Process.—Rud. Gunsberg.—A criticism on Prof. A. Bauer's paper on the same subject (*Berichte*, Heft 5, p. 272). The author finds from his experiments that the most advantageous yield of soda by this process depends on regulating the respective proportions of common salt, ammonia, and water, so that at the end of the transformation there may remain a saturated solution of sal-ammoniac. The whole process hinges upon degrees of solubility.

Constitution of Hyposulphurous Acid.—Hans Bunte.—A hypothetical paper.

Constitution of Terebinic Acid.—R. Fittig and B. Mielck.—An examination of the formulæ proposed for certain derivatives of terebinic acid.

On Oroselon.—H. Hlasiwetz.—With reference to the paper by v. Gorup-Besanez (*Berichte*, Heft vii., p. 564) on peucedanin, the author announces that he has been for some time engaged with the investigation of oroselon, a substance extracted from peucedanin.

On Gentianin.—H. Hlasiwetz and J. Habermann.—A preliminary communication. Gentianin (gentisin) is a compound closely related to maclurin, and is easily resolved, by melting caustic potash, into an acid isomeric with protocatechuic acid, $C_7H_6O_4$, phloroglucin, $C_6H_6O_3$, and acetic acid.

No. 9, June 8, 1874.

Crystalline Form and the Molecular Modifications of Selenium.—C. Rammelsberg.—The author finds that sulphur and selenium are isomorphous, and that the parallelism between the two is easily demonstrated. Selenium exhibits four modifications—(1) amorphous, red, soluble; (2) crystalline, red, soluble; (3) granular, grey, insoluble; (4) foliaceous, almost black, insoluble.

Researches on the Constitution of the Nitrol Acids.—V. Meyer and J. Locher.—The authors examine propyl-nitrolic acid, its behaviour with sulphuric acid, the distinctions between propyl-nitrolic and ethyl-nitrolic acids, and the action of nitrous acid upon pseudo-nitro-propan.

Precipitation of Alumina by Borax.—C. Jehn.—The mixture of solutions of borax and alum is generally said to yield a borate of alumina. This is not the case; alumina is precipitated, and the reaction is quantitative.

Researches on the Volume-Constitution of Solid Bodies.—H. Schrœder.—The volumes of the components, and of the respective elements of every compound, are in proportions which may be expressed by simple whole numbers. All volumes can be reduced to a common measure of which they are multiples by whole numbers, if we bear in mind that this common measure varies, within narrow limits, with the crystalline form. For isomorphous bodies of one group it is always constant. Bodies unite only in multiples by whole numbers of equal volumes. All the known corresponding compounds of ammonium and thallium are not merely isomeric, but isosteric (of equal volume). The same rule probably holds good with carbonic acid and nitric acid.

Loss of Nitric Acid in the Manufacture of Sulphuric Acid.—W. Hasenbach.—The loss of nitric acid in the working of the chambers is due to three causes: a portion is retained by the chamber acid; another portion passes into the atmosphere in consequence of imperfect absorption in the Gay-Lussac tower, or faulty conduct of the process; and, lastly, a part is probably reduced to nitrous oxide, or even to free nitrogen. Both in the nitrous tower acid and the chamber acid the nitrogen is present in the state, not of nitrous, but of hyponitric acid. Sulphurous acid reduces the nitric compounds, not merely to nitric oxide, but sometimes to nitrous acid.

History of Chloride of Lime.—C. Schorlemmer.—A controversial notice of Göpner's paper on the same subject.

Communications from the Laboratory of Würzburg University.—J. Wislicenus.—Mixter, Conrad, and Goldberg have been engaged with researches on the derivatives of sodium acetic ether. St. Stephanowitz has prepared hydrargyro-phenyl-xanthogen-amid, $C_{18}H_{20}S_2O_2Hg$, and its silver compound, hydrargyro-phenyl-xanthogen-amid silver nitrate.

New Method of Preparing Durol.—P. Jannasch.—50 grms. of dibrom-dimethyl-benzol, dissolved in benzol, were mixed with iodide of methyl and sodium. The flask was heated in the water-bath. Two distillates were obtained, a liquid and a crystalline, the latter of which had the boiling-point of durol.

Æthyl-Diacetic Acid.—E. Lippmann.—The author maintains that he has anticipated Mixter by six years in the "new" method of preparing this acid, described in No. 7.

Correction.—R. Wagner.—In reference to Professor v. Gorup's paper (*Berichte*, p. 568), the author shows that imperatorin has been analysed by F. Dœbereiner, and its identity with peucedanin has been shown by himself, as appears on reference to Gmelin's "Handbook."

Addition-Product of Bromacetic Acid with Methyl-Sulphide and its Derivatives.—Crum Brown and E. A. Letts.—The object of this paper is to extend the analogy between sulphur and nitrogen, first shown in Oefele's sulphin compounds.

Oxidation of Butyric, Capronic, Succinic, and Oxalic Acids by Nitric Acid.—E. Erlenmeyer, O. Sigel, and L. Belli.—The authors find that normal butyric acid can be converted by nitric acid into succinic acid. Normal capronic acid is oxidised in the same manner to succinic and acetic acids. Succinic and oxalic acids are completely converted into carbonic acid and water, by dilute nitric acid, without the formation of any tangible intermediate products. Acetic acid is scarcely attacked by strong nitric acid, even at elevated temperatures.

Amido-Caprylic and Hydroxyl-Caprylic Acids.— E. Erlenmeyer and O. Sigel.—The former of these acids forms white nacreous leaflets, perfectly neutral to test-paper, which, if cautiously heated, volatilise undecomposed and without previous fusion. They are insoluble in ether, and sparingly soluble in water and alcohol. Hydroxyl-caprylic acid crystallises in small colourless leaflets, fusible at 69·5°, sparingly soluble in water, but readily in alcohol and ether.

Preparation of Methylic Ether.— E. Erlenmeyer and A. Kriechbaumer.—A mixture of 1·3 parts of methylic alcohol and 2 parts of sulphuric ether are heated in a flask fitted with a cohobator. The temperature is gradually raised to 140°, a thermometer being immersed in the liquid. The gas is washed in soda-lye, and conducted into sulphuric acid surrounded by cold water, which absorbs and retains 600 volumes, and from which it can be liberated by the gradual addition of water.

Certain Salts of Boracic Acid.— R. Benedikt.—A valuable paper, but not adapted for abstraction.

Sulpho Compounds of the Three Isomeric Phthalic Acids.— Jos. Schreder.—The author prepares and examines thiophthalic acid, and the sulpho compounds of terephthalic and isophthalic acids.

Correction.— A. Bauer.—A controversial note, referring to Günsberg's paper on the ammonia-soda process (*Berichte*, 272).

On Nitrobutan.— E. Demole.—Nitrobutan, $C_4H_9NO_2$, is a faintly yellow oil, with an odour resembling that of peppermint.—It boils at 137° to 140°. It is dissolved by potash-lye, and re-precipitated by acids, but does not yield a precipitate with alcoholic solution of soda. By the action of iron and acetic acid nitrobutan is converted into butylamin.

Researches on Substitution in Nitrised Fatty Bodies.— V. Meyer and J. Tschermak.—The authors examine dibrom-nitro-ethan, normal and pseudo nitro-propan, the bromine substitution products of the nitro-propans, the action of bromine upon potassium-pseudo-nitro-propan, and upon the normal compound.

Communications from the Greifswald Laboratory. —H. Limpricht.—Fuming sulphuric acid acting upon paratoluydin forms an ortho- and a meta-sulph acid, along with an acid disulpho compound. The two latter have been examined by Dr. v. Pechmann. The meta-sulph acid, on distillation with hydrate of potassa, yields para-toluydin, but if briskly heated in a capsule para-oxy-benzoic acid is formed, with traces of proto-catechuic acid. The diazo compound, formed on treating the meta-sulph acid with nitrous acid, yields, on decomposition with alcohol under pressure, meta-sulpho-toluylic acid, which forms colourless deliquescent crystals. On boiling the diazo compound in water, para-cresol-meta-sulph acid is obtained.

Convenient Preparation of Cuprous Chloride.— K. Heumann.—14·2 parts of powdered oxide of copper are intimately mixed with 7 parts of common zinc powder, and the whole is put very gradually into crude concentrated hydrochloric acid in a beaker with constant stirring. As soon as a white sediment appears more hydrochloric acid is poured in, and the addition of the powder is resumed till the whole quantity is consumed. Finally, if a white powder has been deposited more hydrochloric acid is added, the yellowish brown liquid is allowed to settle for a few moments, and without stirring up the slight precipitate of metallic copper is poured into a flask, which is filled up with boiled water and stoppered. The cuprous chloride soon separates as a snow-white crystalline powder, which is washed with distilled water, and dried in darkness.

Desulphurisation of the Oil of Mustard.— W. Weith. —The author's results on the desulphurisation of the phenyl mustard oil, by means of metallic copper, differ essentially from those of A. W. Hofmann (*Berichte*, vii., page 522).

A New Constituent of Benzoin from Sumatra.— Albert Theegarten.—A preliminary notice. Besides benzoic acid, and Unverdorben's three resins, the author finds in Sumatra benzoin a volatile essential oil, of an odour resembling both that of benzol and of naphthalin. In Siamese samples it was not detected.

Correspondence from St. Petersburg.— A. Kuhlberg. —A. Buttlerow has been engaged with the examination of trimethyl-acetic acid, and the constitution of pinakolin.

Pawlow has prepared dimethyl-isobutyl-carbinol, and obtained from it a new heptylen.

A. Wischnegrodsky has examined dimethyl-ethyl-acetic acid, a new isomer of capronic acid.

Beilstein and Kurbatow, by acting with iodine upon an alcoholic solution of chlor-phenyl-sulphurea,—
$$CS(NC_6H_4ClH)_2,$$
obtain, besides, chloro-phenyl oil of mustard, C_6H_4ClNCS; and trichlor-phenyl-guanidin, $CH_2(C_6H_4Cl)_3N_3$; and sulphur, chlor-aniline, chloro-phenyl-urea, and a sulphur compound which crystallises in needles.
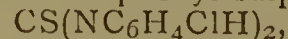
G. Gustavson obtains iodethyliden from chlorethyliden, by adding the latter to a solution of iodide of aluminium in sulphide of carbon.

Tawildarow obtained $C_4H_7BrO_2$ by heating bromacetyl with aldehyd to 130° in a sealed tube.

Mendelejew reports on an improved mercurial air-pump.

Ley and Popoff have studied the oxidation of the secondary oxyacids of the fatty series.

Potilizin gives a preliminary announcement of his researches on the mutual displacement of the haloids in their compounds.

Gagarin has examined the isomeric compounds of the formula C_2H_4BrI.

Goldstein finds that on the cautious oxidation of volatile nitro-phenol by permanganic acid two nitro-phenols are united, and two atoms of hydrogen separated out.

Reimann's Farber Zeitung, No. 23, 1874.

This number contains directions for dyeing leather with aniline colours.

An absurd receipt for dyeing an orange on cotton—but calculated to produce a brown—is copied from a rival technological paper.

There are also receipts for a green on half-wool garments; for bleaching cotton; for an iron buff on cotton pieces; for a grey on wool; a very pale grey, a greenish mode grey, a reddish mode grey, a darker shade of the same, and a light Havanna on cloth; a scarlet on cotton-yarn; an opal blue on cotton-yarn and calico; and a vat blue, topped with logwood, on cotton yarn.

For brightening greys on wool and mixed goods it is recommended to top them with indulin, known otherwise as indigo substitute.

Wool may be dyed with iodine green in the same manner as with Nicholson blue. For 10 lbs. of wool 100 grms. of iodine green, and 500 grms. of borax, are dissolved in water at 40° R. The raising bath should contain 150 grms. of sulphuric acid.

No. 24, 1874.

The editor shows the unprofitable nature of a " fast blue without indigo "—which, further, is not fast—recommended by one of his contemporaries, and advises the use in its stead of a vat blue topped with logwood.

The article on dyeing leather with the coal-tar colours is concluded with the following receipt for glazing:— Dissolve 100 grms. lactarin in 1 litre water at 60° R., with the addition of strong ammonia as required. This glaze is particularly recommended for red shades, aniline, violets, iodine green, &c.

Unger has come forward with a lengthy paper in defence of his former assertion that ultramarine contains nitrogen as an essential constituent.

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BRITISH ASSOCIATION

FOR THE

ADVANCEMENT OF SCIENCE.

BELFAST MEETING, AUGUST 19, 1874.

INAUGURAL ADDRESS OF THE PRESIDENT,

JOHN TYNDALL, F.R.S., D.C.L. Oxon, LL.D. Cantab., F.C.P.S., Professor of Natural Philosophy in the Royal Institution.

AN impulse inherent in primeval man turned his thoughts and questionings betimes towards the sources of natural phenomena. The same impulse, inherited and intensified, is the spur of scientific action to-day. Determined by it, by a process of abstraction from experience we form physical theories which lie beyond the pale of experience, but which satisfy the desire of the mind to see every natural occurrence resting upon a cause. In forming their notions of the origin of things, our earliest historic (and doubtless, we might add, our pre-historic) ancestors pursued, as far as their intelligence permitted, the same course. They also fell back upon experience, but with this difference—that the particular experiences which furnished the weft and woof of their theories were drawn, not from the study of Nature, but from what lay much closer to them, the observation of men. Their theories accordingly took an anthropomorphic form. To super-sensual beings, which, " however potent and invisible, were nothing but a species of human creatures, perhaps raised from among mankind, and retaining all human passions and appetites," * were handed over the rule and governance of natural phenomena.

Tested by observation and reflection, these early notions failed in the long run to satisfy the more penetrating intellects of our race. Far in the depths of history we find men of exceptional power differentiating themselves from the crowd, rejecting these anthropomorphic notions, and seeking to connect natural phenomena with their physical principles. But long prior to these purer efforts of the understanding the merchant had been abroad, and rendered the philosopher possible ; commerce had been developed, wealth amassed, leisure for travel and for speculation secured, while races educated under different conditions— and therefore differently informed and endowed — had been stimulated and sharpened by mutual contact. In those regions where the commercial aristocracy of ancient Greece mingled with its eastern neighbours, the sciences were born, being nurtured and developed by free-thinking and courageous men. The state of things to be displaced may be gathered from a passage of Euripides quoted by Hume :—" There is nothing in the world ; no glory, no prosperity. The gods toss all into confusion ; mix everything with its reverse, that all of us, from our ignorance and uncertainty, may pay them the more worship and reverence." Now, as science demands the radical extirpation of caprice and the absolute reliance upon law in Nature, there grew with the growth of scientific notions a desire and determination to sweep from the field of theory this mob of gods and demons, and to place natural phenomena on a basis more congruent with themselves.

The problem which had been previously approached from above was now attacked from below ; theoretic effort passed from the super- to the sub-sensible. It was felt that to construct the universe in idea it was necessary to

* Hume, " Natural History of Religion."

have some notion of its constituent parts—of what Lucretius subsequently called the " First Beginnings." Abstracting again from experience, the leaders of scientific speculation reached at length the pregnant doctrine of atoms and molecules, the latest developments of which were set forth with such power and clearness at the last meeting of the British Association. Thought no doubt had long hovered about this doctrine before it attained the precision and completeness which it assumed in the mind of Democritus,* a philosopher who may well for a moment arrest our attention. " Few great men," says Lange, in his excellent " History of Materialism," a work to the spirit and the letter of which I am equally indebted, " have been so despitefully used by history as Democritus. In the distorted images sent down to us through unscientific traditions there remains of him almost nothing but the name of ' the laughing philosopher,' while figures of immeasurably smaller significance spread themselves at full length before us." Lange speaks of Bacon's high appreciation of Democritus—for ample illustrations of which I am indebted to my excellent friend Mr. Spedding, the learned editor and biographer of Bacon. It is evident, indeed, that Bacon considered Democritus to be a man of weightier metal than either Plato or Aristotle, though their philosophy " was noised and celebrated in the schools, amid the din and pomp of professors." It was not they, but Genseric and Attila and the barbarians, who destroyed the atomic philosophy. " For at a time when all human learning had suffered shipwreck, these planks of Aristotelian and Platonic philosophy, as being of a lighter and more inflated substance, were preserved and came down to us, while things more solid sank and almost passed into oblivion."

The principles enunciated by Democritus reveal his uncompromising antagonism to those who deduced the phenomena of nature from the caprices of the gods. They are briefly these:—1. From nothing comes nothing. Nothing that exists can be destroyed. All changes are due to the combination and separation of molecules. 2. Nothing happens by chance. Every occurrence has its cause from which it follows by necessity. 3. The only existing things are the atoms and empty space ; all else is mere opinion. 4. The atoms are infinite in number, and infinitely various in form ; they strike together, and the lateral motions and whirlings which thus arise are the beginnings of worlds. 5. The varieties of all things depend upon the varieties of their atoms, in number, size, and aggregation. 6. The soul consists of free, smooth, round atoms, like those of fire. These are the most mobile of all. They interpenetrate the whole body, and in their motions the phenomena of life arise. Thus the atoms of Democritus are individually without sensation ; they combine in obedience to mechanical laws ; and not only organic forms, but the phenomena of sensation and thought are also the result of their combination.

That great enigma, " the exquisite adaptation of one part of an organism to another part, and to the conditions of life," more especially the construction of the human body, Democritus made no attempt to solve. Empedocles a man of more fiery and poetic nature, introduced the notion of love and hate among the atoms to account for their combination and separation. Noticing this gap in the doctrine of Democritus, he struck in with the penetrating thought—linked, however, with some wild speculation—that it lay in the very nature of those combinations which were suited to their ends (in other words, in harmony with their environment) to maintain themselves while unfit combinations, having no proper habitat, must rapidly disappear. Thus more than 2000 years ago the doctrine of the " survival of the fittest," which in our day —not on the basis of vague conjecture, but of positive knowledge—has been raised to such extraordinary significance, had received at all events partial enunciation.†

* Born 460 B.C.
† Lange, 2nd edit., p. 23.

Epicurus,[*] said to be the son of a poor schoolmaster at Samos, is the next dominant figure in the history of the atomic philosophy. He mastered the writings of Democritus, heard lectures in Athens, returned to Samos, and subsequently wandered through various countries. He finally returned to Athens, where he bought a garden, and surrounded himself by pupils, in the midst of whom he lived a pure and serene life, and died a peaceful death. His philosophy was almost identical with that of Democritus, but he never quoted either friend or foe. One main object of Epicurus was to free the world from superstition and the fear of death. Death he treated with indifference. It merely robs us of sensation. As long as we are, death is not; and when death is, we are not. Life has no more evil for him who has made up his mind that it is no evil not to live. He adored the gods, but not in the ordinary fashion. The idea of divine power, properly purified, he thought an elevating one. Still he taught—" Not he is godless who rejects the gods of the crowd, but rather he who accepts them." The gods were to him eternal and immortal beings, whose blessedness excluded every thought of care or occupation of any kind. Nature pursues her course in accordance with everlasting laws, the gods never interfering. They haunt—

> " The lucid interspace of world and world
> Where never creeps a cloud or moves a wind,
> Nor ever falls the least white star of snow,
> Nor ever lowest roll of thunder moans,
> Nor sound of human sorrow mounts to mar
> Their sacred everlasting calm."[†]

Lange considers the relation of Epicurus to the gods subjective; the indication, probably, of an ethical requirement of his own nature. We cannot read history with open eyes, or study human nature to its depths, and fail to discern such a requirement. Man never has been, and he never will be, satisfied with the operations and products of the Understanding alone; hence physical science cannot cover all the demands of his nature. But the history of the efforts made to satisfy these demands might be broadly described as a history of errors—the error consisting in ascribing fixity to that which is fluent, which varies as we vary, being gross when we are gross, and becoming, as our capacities widen, more abstract and sublime. On one great point the mind of Epicurus was at peace. He neither sought nor expected, here or hereafter, any personal profit from his relation to the gods. And it is assuredly a fact that loftiness and serenity of thought may be promoted by conceptions which involve no idea of profit of this kind. " Did I not believe," said a great man to me once, " that an Intelligence is at the heart of things, my life on earth would be intolerable." The utterer of these words is not, in my opinion, rendered less noble, but more noble, by the fact that it was the need of ethical harmony here, and not the thought of personal profit hereafter, that prompted his observation.

A century and a half after the death of Epicurus, Lucretius[‡] wrote his great poem, " On the Nature of Things," in which he, a Roman, developed with extraordinary ardour the philosophy of his Greek predecessor. He wishes to win over his friend Memmius to the school of Epicurus; and although he has no rewards in a future life to offer, although his object appears to be a purely negative one, he addresses his friend with the heat of an apostle. His object, like that of his great forerunner, is the destruction of superstition; and considering that men trembled before every natural event as a direct monition from the gods, and that everlasting torture was also in prospect, the freedom aimed at by Lucretius might perhaps be deemed a positive good. " This terror," he says, " and darkness of mind must be dispelled, not by the rays of the sun and glittering shafts of day, but by the aspect and the law of Nature." He refutes the notion that anything can come out of nothing, or that which is once begotten can be recalled to nothing. The first beginnings,

the atoms, are indestructible, and into them all things can be dissolved at last. Bodies are partly atoms, and partly combinations of atoms; but the atoms nothing can quench. They are strong in solid singleness, and by their denser combination all things can be closely packed and exhibit enduring strength. He denies that matter is infinitely divisible. We come at length to the atoms, without which, as an imperishable substratum, all order in the generation and development of things would be destroyed.

The mechanical shock of the atoms being in his view the all-sufficient cause of things, he combats the notion that the constitution of Nature has been in any way determined by intelligent design. The interaction of the atoms throughout infinite time rendered all manner of combinations possible. Of these the fit ones persisted, while the unfit ones disappeared. Not after sage deliberation did the atoms station themselves in their right places, nor did they bargain what motions they should assume. From all eternity they have been driven together, and, after trying motions and unions of every kind, they fell at length into the arrangements out of which this system of things has been formed. His grand conception of the atoms falling silently through immeasurable ranges of space and time suggested the nebular hypothesis to Kant, its first propounder,—" If you will apprehend and keep in mind these things, Nature, free at once, and rid of her haughty lords, is seen to do all things spontaneously of herself, without the meddling of the gods."[*]

During the centuries between the first of these three philosophers and the last, the human intellect was active in other fields than theirs. The sophists had run through their career. At Athens had appeared the three men— Socrates, Plato, and Aristotle—whose yoke remains to some extent unbroken to the present hour. Within this period, also, the School of Alexandria was founded, Euclid wrote his " Elements," and he and others made some advance in optics. Archimedes had propounded the theory of the lever, and the principles of hydrostatics. Pythagoras had made his experiments on the harmonic intervals, while astronomy was immensely enriched by the discoveries of Hipparchus, who was followed by the historically more celebrated Ptolemy. Anatomy had been made the basis of Scientific medicine, and it is said by Draper[†] that vivisection then began. In fact the Science of ancient Greece had already cleared the world of the fantastic images of divinities operating capriciously through natural phenomena. It had shaken itself free from that fruitless scrutiny " by the internal light of the mind alone," which had vainly sought to transcend experience and reach a knowledge of ultimate causes. Instead of accidental observation, it had introduced observation with a purpose; instruments were employed to aid the senses; and scientific method was rendered in a great measure complete by the union of Induction and Experiment.

What, then, stopped its victorious advance? Why was the scientific intellect compelled, like an exhausted soil, to lie fallow for nearly two millenniums before it could regather the elements necessary to its fertility and strength? Bacon has already let us know one cause; Whewell ascribes this stationary period to four causes—obscurity of thought, servility, intolerance of disposition, enthusiasm of temper; and he gives striking examples of each.[‡] But these characteristics must have had their causes, which lay in the circumstances of the time. Rome, and the other cities of the Empire, had fallen into moral putrefaction. Christianity had appeared, offering the Gospel to the poor, and, by moderation if not asceticism of life, practically protesting against the profligacy of the age.

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[*] Monro's translation. In his criticism of this work (" Contemporary Review," 1867) Dr. Hayman does not appear to be aware of the really sound and subtile observations on which the reasoning of Lucretius, though erroneous, sometimes rests.
[†] " History of the Intellectual Development of Europe," p. 295.
[‡] " History of the Inductive Sciences," vol. i.

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[*] Born 342 B.C.
[†] Tennyson's " Lucretius."
[‡] Born 99 B.C.

The sufferings of the early Christians and the extraordinary exaltation of mind which enabled them to triumph over the diabolical tortures to which they were subjected,* must have left traces not easily effaced. They scorned the earth, in view of that " building of God, that house not made with hands, eternal in the heavens." The Scriptures which ministered to their spiritual needs were also the measure of their Science. When, for example, the celebrated question of antipodes came to be discussed, the Bible was with many the ultimate court of appeal. Augustine, who flourished A.D. 400, would not deny the rotundity of the earth; but he would deny the possible existence of inhabitants at the other side, " because no such race is recorded in Scripture among the descendants of Adam." Archbishop Boniface was shocked at the assumption of a " world of human beings out of the reach of the means of salvation." Thus reined in, Science was not likely to make much progress. Later on the political and theological strife between the Church and civil governments, so powerfully depicted by Draper, must have done much to stifle investigation.

Whewell makes many wise and brave remarks regarding the spirit of the Middle Ages. It was a menial spirit. The seekers after natural knowledge had forsaken that fountain of living waters, the direct appeal to Nature by observation and experiment, and had given themselves up to the re-manipulation of the notions of their predecessors. It was a time when thought had become abject, and when the acceptance of mere authority led, as it always does in science, to intellectual death. Natural events, instead of being traced to physical, were referred to moral causes; while an exercise of the phantasy, almost as degrading as the spiritualism of the present day, took the place of scientific speculation. Then came the mysticism of the Middle Ages, magic, alchemy, the neo-platonic philosophy, with its visionary though sublime abstractions, which caused men to look with shame upon their own bodies as hindrances to the absorption of the creature in the blessedness of the Creator. Finally came the Scholastic philosophy, a fusion, according to Lange, of the least-mature notions of Aristotle with the Christianity of the west. Intellectual immobility was the result. As a traveller without a compass in a fog may wander long, imagining he is making way, and finding himself after hours of toil at his starting-point, so the schoolmen, having tied and untied the same knots, and formed and dissipated the same clouds, found themselves at the end of centuries in their old position.

With regard to the influence wielded by Aristotle in the Middle Ages, and which, though to a less extent, he still wields, I would ask permission to make one remark. When the human mind has achieved greatness and given evidence of extraordinary power in any domain, there is a tendency to credit it with similar power in all other domains. Thus theologians have found comfort and assurance in the thought that Newton dealt with the question of revelation, forgetful of the fact that the very devotion of his powers, through all the best years of his life, to a totally different class of ideas, not to speak of any natural disqualification, tended to render him less instead of more competent to deal with theological and historic questions. Goethe, starting from his established greatness as a poet, and indeed from his positive discoveries in natural history, produced a profound impression among the painters of Germany when he published his " Farbenlehre," in which he endeavoured to overthrow Newton's theory of colours. This theory he deemed so obviously absurd, that he considered its author a charlatan, and attacked him with a corresponding vehemence of language. In the domain of natural history Goethe had made really considerable discoveries; and we have high authority for assuming that, had he devoted himself wholly to that side of science, he might have reached in it an eminence comparable with that which he attained as a poet. In sharpness of observation, in the detection of

analogies however apparently remote, in the classification and organisation of facts according to the analogies discerned, Goethe possessed extraordinary powers. These elements of scientific inquiry fall in with the discipline of the poet. But, on the other hand, a mind thus richly endowed in the direction of natural history may be almost shorn of endowment as regards the more strictly called physical and mechanical sciences. Goethe was in this condition. He could not formulate distinct mechanical conceptions: he could not see the force of mechanical reasoning; and in regions where such reasoning reigns supreme he became a mere *ignis fatuus* to those who followed him.

I have sometimes permitted myself to compare Aristotle with Goethe, to credit the Stagirite with an almost super-human power of amassing and systematising facts, but to consider him fatally defective on that side of the mind in respect to which incompleteness has been just ascribed to Goethe. Whewell refers the errors of Aristotle, not to a neglect of facts, but to " a neglect of the idea appropriate to the facts; the idea of Mechanical cause, which is Force, and the substitution of vague or inapplicable notions, involving only relations of space or emotions of wonder." This is doubtless true; but the word " neglect " implies mere intellectual misdirection; whereas in Aristotle, as in Goethe, it was not, I believe, misdirection, but sheer natural incapacity which lay at the root of his mistakes. As a physicist, Aristotle displayed what we should consider some of the worst attributes of a modern physical investigator—indistinctness of ideas, confusion of mind, and a confident use of language, which led to the delusive notion that he had really mastered his subject, while he as yet had failed to grasp even the elements of it. He put words in the place of things, subject in the place of object. He preached induction without practising it, inverting the true order of inquiry by passing from the general to the particular, instead of from the particular to the general. He made of the universe a closed sphere, in the centre of which he fixed the earth, proving from general principles, to his own satisfaction and to that of the world for near 2000 years, that no other universe was possible. His notions of motion were entirely unphysical. It was natural or unnatural, better or worse, calm or violent—no real mechanical conception regarding it lying at the bottom of his mind. He affirmed that a vacuum could not exist, and proved that if it did exist motion in it would be impossible. He determined *a priori* how many species of animals must exist, and shows on general principles why animals must have such and such parts. When an eminent contemporary philosopher, who is far removed from errors of this kind, remembers these abuses of the *a priori* method, he will be able to make allowance for the jealousy of physicists as to the acceptance of so-called *a priori* truths. Aristotle's errors of detail were grave and numerous. He affirmed that only in man we had the bearing of the heart, that the left side of the body was colder that the right, that men have more teeth than women, and that there is an empty space, not at the front, but at the back of every man's head.

There is one essential quality in physical conceptions which was entirely wanting in those of Aristotle and his followers. I wish it could be expressed by a word untainted by its associations; it signifies a capability of being placed as a coherent picture before the mind. The Germans express the act of picturing by the word *vorstellen*, and the picture they call a *Vorstellung*. We have no word in English which comes nearer to our requirements than *Imagination*, and, taken with its proper limitations, the word answers very well; but, as just intimated, it is tainted by its associations, and therefore objectionable to some minds. Compare, with reference to this capacity of mental presentation, the case of the Aristotelian, who refers the ascent of water in a pump to Nature's abhorrence of a vacuum, with that of Pascal when he proposed to solve the question of atmospheric pressure by the ascent of the Puy de Dome. In the one case, the terms of the

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* Depicted with terrible vividness in Rénan's " Antichrist."

explanation refuse to fall into place as a physical image; in the other the image is distinct, the fall and rise of the barometer being clearly figured as the balancing of two varying and opposing pressures.

During the drought of the Middle Ages in Christendom, the Arabian intellect, as forcibly shown by Draper, was active. With the intrusion of the Moors into Spain, cleanliness, order, learning, and refinement took the place of their opposites. When smitten with disease the Christian peasant resorted to a shrine, the Moorish one to an instructed physician. The Arabs encouraged translations from the Greek philosophers, but not from the Greek poets. They turned in disgust "from the lewdness of our classical mythology, and denounced as an unpardonable blasphemy all connection between the impure Olympian Jove and the Most High God." Draper traces still further than Whewell the Arab elements in our scientific terms, and points out that the under garment of ladies retains to this hour its Arab name. He gives examples of what Arabian men of science accomplished, dwelling particularly on Alhazen, who was the first to correct the Platonic notion that rays of light are emitted by the eye. He discovered atmospheric refraction, and points out that we see the sun and moon after they have set. He explains the enlargement of the sun and moon, and the shortening of the vertical diameters of both these bodies when near the horizon. He is aware that the atmosphere decreases in density with increase of height, and actually fixes its height at $58\frac{1}{2}$ miles. In the Book of the Balance Wisdom, he sets forth the connection between the weight of the atmosphere and its increasing density. He shows that a body will weigh differently in a rare and a dense atmosphere: he considers the force with which plunged bodies rise through heavier media. He understands the doctrine of the centre of gravity, and applies it to the investigation of balances and steelyards. He recognises gravity as a force, though he falls into the error of making it diminish as the distance, and of making it purely terrestrial. He knows the relation between the velocities, spaces, and times of falling bodies, and has distinct ideas of capillary attraction. He improves the hydrometer. The determination of the densities of bodies as given by Alhazen approach very closely to our own. "I join," says Draper, in the pious prayer of Alhazen, "that in the day of judgment the All-Merciful will take pity on the soul of Abur-Raihân, because he was the first of the race of men to construct a table of specific gravities." If all this be historic truth (and I have entire confidence in Dr. Draper), well may he "deplore the systematic manner in which the literature of Europe has contrived to put out of sight our scientific obligations to the Mahommedans."*

Towards the close of the stationary period a word-weariness, if I may so express it, took more and more possession of men's minds. Christendom had become sick of the School philosophy and its verbal wastes, which led to no issue, but left the intellect in everlasting haze. Here and there was heard the voice of one impatiently crying in the wilderness, "Not unto Aristotle, not unto subtle hypotheses, not unto church, bible, or blind tradition, must we turn for a knowledge of the universe, but to the direct investigation of nature by observation and experiment." In 1543 the epoch-making work of Copernicus on the paths of the heavenly bodies appeared. The total crash of Aristotle's closed universe with the earth at its centre followed as a consequence; and "the earth moves" became a kind of watchword among intellectual freemen. Copernicus was Canon of the church of Frauenburg in the diocese of Ermeland. For three-and-thirty years he had withdrawn himself from the world, and devoted himself to the consolidation of his great scheme of the solar system. He made its blocks eternal: and even to those who feared it and desired its overthow it was so obviously strong that they refrained for a time from meddling with it. In the last year of the life of Copernicus his book

* "Intellectual Development of Europe," p. 359.

appeared: it is said that the old man received a copy of it a few days before his death, and then departed in peace.

The Italian philosopher Giordano Bruno was one of the earliest converts to the new astronomy. Taking Lucretius as his exemplar, he revived the notion of the infinity of worlds; and, combining with it the doctrine of Copernicus, reached the sublime generalisation that the fixed stars are suns, scattered numberless through space and accompanied by satellites, which bear the same relation to them that our earth does to our sun, or our moon to our earth. This was an expansion of transcendent import; but Bruno came closer than this to our present line of thought. Struck with the problem of the generation and maintenance of organisms, and duly pondering it, he came to the conclusion that Nature in her productions does not imitate the technic of man. Her process is one of unravelling and unfolding. The infinity of forms under which matter appears were not imposed upon it by an external artificer; by its own intrinsic force and virtue it brings these forms forth. Matter is not the mere naked empty *capacity* which philosophers have pictured her to be, but the universal mother, who brings forth all things as the fruit of her own womb.

This outspoken man was originally a Dominican monk. He was accused of heresy, and had to fly, seeking refuge in Geneva, Paris, England, and Germany. In 1592 he fell into the hands of the Inquisition at Venice. He was imprisoned for many years, tried, degraded, excommunicated, and handed over to the civil power, with the request that he should be treated gently, and "without the shedding of blood." This meant that he was to be burnt; and burnt accordingly he was, on the 16th of February, 1600. To escape a similar fate Galileo, thirty-three years afterwards, abjured, upon his knees, and with his hand upon the holy gospels, the heliocentric doctrine. After Galileo came Kepler, who from his German home defied the power beyond the Alps. He traced out from pre-existing observations the laws of planetary motion. The problem was thus prepared for Newton, who bound those empirical laws together by the principle of gravitation.

During the Middle Ages the doctrine of atoms had to all appearance vanished from discussion. In all probability it held its ground among sober-minded and thoughtful men, though neither the church nor the world was prepared to hear of it with tolerance. Once, in the year 1348, it received distinct expression. But retractation by compulsion immediately followed, and, thus discouraged, it slumbered till the 17th century, when it was revived by a contemporary of Hobbes and Descartes, the Père Gassendi.

The analytic and synthetic tendencies of the human mind exhibit themselves throughout history, great writers ranging themselves sometimes on the one side, sometimes on the other. Men of lofty feelings, and minds open to the elevating impressions produced by Nature as a whole, whose satisfaction, therefore, is rather ethical than logical, have leaned to the synthetic side; while the analytic harmonises best with the more precise and more mechanical bias which seeks the satisfaction of the understanding. Some form of Pantheism was usually adopted by the one, while a detached Creator, working more or less after the manner of men, was often assumed by the other.* Gassendi is hardly to be ranked with either. Having formally acknowledged God as the great first cause, he immediately drops the idea, applies the known laws of mechanics to the atoms, and thence deduces all vital phenomena. God who created earth and water, plants and animals, produced in the first place a definite number of atoms, which constituted the seed of all things. Then

* Boyle's model of the universe was the Strasburg clock with an outside Artificer. Goethe, on the other hand, sang

"Ihm ziemt's die Welt im Innern zu bewegen,
    Natur in sich, sich in Natur zu hegen."

The same repugnance to the Clockmaker conception is manifest in Carlyle,

began that series of combinations and decompositions which goes on at the present day, and which will continue in the future. The principle of every change resides in matter. In artificial productions the moving principle is different from the material worked upon; but in Nature the agent works within, being the most active and mobile part of the material itself. Thus this bold ecclesiastic, without incurring the censure of the church or the world, contrives to outstrip Mr. Darwin. The same cast of mind which caused him to detach the Creator from his universe led him also to detach the soul from the body, though to the body he ascribes an influence so large as to render the soul almost unnecessary. The aberrations of reason were in his view an affair of the material brain. Mental disease is brain disease; but then the immortal reason sits apart, and cannot be touched by the disease. The errors of madness are errors of the instrument, not of the performer.

It may be more than a mere result of education, connecting itself probably with the deeper mental structure of the two men, that the idea of Gassendi, above enunciated, is substantially the same as that expressed by Professor Clerk Maxwell at the close of the very noble lecture delivered by him at Bradford last year. According to both philosophers, the atoms, if I understand aright, are the *prepared materials*, the "manufactured articles," which, formed by the skill of the Highest, produce by their subsequent inter-action all the phenomena of the material world. There seems to be this difference, however, between Gassendi and Maxwell. The one *postulates*, the other *infers*, his first cause. In his manufactured articles, Professor Maxwell finds the basis of an induction, which enables him to scale philosophic heights considered inaccessible by Kant, and to take the logical step from the atoms to their Maker.

The atomic doctrine, in whole or in part, was entertained by Bacon, Descartes, Hobbes, Locke, Newton, Boyle, and their successors, until the chemical law of multiple proportions enabled Dalton to confer upon it an entirely new significance. In our day there are secessions from the theory, but it still stands firm. Only a year or two ago Sir William Thomson, with characteristic penetration, sought to determine the sizes of the atoms, or rather to fix the limits between which their sizes lie; while only last year the discourses of Williamson and Maxwell illustrate the present hold of the doctrine upon the foremost scientific minds. What these atoms, self-moved and self-posited, can and cannot accomplish in relation to life, is at the present moment the subject of profound scientific thought. I doubt the legitimacy of Maxwell's logic; but it is impossible not to feel the ethic glow with which his lecture concludes. There is, moreover, a Lucretian grandeur in his description of the steadfastness of the atoms:—"Natural causes, as we know, are at work, which tend to modify, if they do not at length destroy, all the arrangements and dimensions of the earth and the whole solar system. But, though in the course of ages catastrophes have occurred and may yet occur in the heavens, though ancient systems may be dissolved and new systems evolved out of their ruins, the molecules out of which these systems are built, the foundation stones of the material universe, remain unbroken and unworn."

Ninety years subject to Gassendi, the doctrine of bodily instruments, as it may be called, assumed immense importance in the hands of Bishop Butler, who, in his famous "Analogy of Religion," developed, from his own point of view, and with consummate sagacity, a similar idea. The Bishop still influences superior minds; and it will repay us to dwell for a moment on his views. He draws the sharpest distinction between our real selves and our bodily instruments. He does not, as far as I remember, use the word soul, possibly because the term was so hackneyed in his day as it had been for many generations previously. But he speaks of "living powers," "perceiving" or "percipient powers," "moving agents," "ourselves," in the same sense as we should employ the

term soul. He dwells upon the fact that limbs may be removed, and mortal diseases assail the body, while the mind, almost up to the moment of death, remains clear. He refers to sleep and to swoon, where the "living powers" are suspended but not destroyed. He considers it quite as easy to conceive of an existence out of our bodies as in them; that we may animate a succession of bodies, the dissolution of all of them having no more tendency to dissolve our real selves, or "deprive us of living faculties—the faculties of perception and action—than the dissolution of any foreign matter which we are capable of receiving impressions from, or making use of for the common occasions of life." This is the key of the Bishop's position: "our organised bodies are no more a part of ourselves than any other matter around us." In proof of this he calls attention to the use of glasses, which "prepare objects" for the "percipient power" exactly as the eye does. The eye itself is no more percipient than the glass, and is quite as much the instrument of the true self, and also as foreign to the true self, as the glass is. "And if we see with our eyes only in the same manner as we do with glasses, the like may justly be concluded from analogy of all our senses."

Lucretius, as you are aware, reached a precisely opposite conclusion; and it certainly would be interesting, if not profitable, to us all, to hear what he would or could urge in opposition to the reasoning of the Bishop. As a brief discussion of the point will enable us to see the bearings of an important question, I will here permit a disciple of Lucretius to try the strength of the Bishop's position, and then allow the Bishop to retaliate, with the view of rolling back, if he can, the difficulty upon Lucretius. Each shall state his case fully and frankly; and you shall be umpire between them.

The argument might proceed in this fashion:—

"Subjected to the test of mental presentation *(Vorstellung)*, your views, most honoured prelate, would present to many minds a great, if not an insuperable, difficulty. You speak of 'living powers,' 'percipient or perceiving powers,' and 'ourselves;' but can you form a mental picture of any one of these apart from the organism through which it is supposed to act? Test yourself honestly, and see whether you possess any faculty that would enable you to form such a conception. The true self has a local habitation in each of us; thus localised, must it not possess a form? If so, what form? Have you ever for a moment realised it? When a leg is amputated, the body is divided into two parts; is the true self in both of them or in one? Thomas Aquinas might say in both; but not you, for you appeal to the consciousness associated with one of the two parts to prove that the other is foreign matter. Is consciousness, then, a necessary element of the true self? If so, what do you say to the case of the whole body being deprived of consciousness? If not, then on what grounds do you deny any portion of the true self to the severed limb? It seems very singular that, from the beginning to the end of your admirable book (and no one admires its sober strength more than I do), you never once mention the brain or nervous system. You begin at one end of the body, and show that its parts may be removed without prejudice to the perceiving power. What if you begin at the other end, and remove, instead of the leg, the brain? The body, as before, is divided into two parts; but both are now in the same predicament, and neither can be appealed to to prove that the other is foreign matter. Or, instead of going so far as to remove the brain itself, let a certain portion of its bony covering be removed, and let a rhythmic series of pressures and relaxations of pressure be applied to the soft substance. At every pressure 'the faculties of perception and of action' vanish; at every relaxation of pressure they are restored. Where, during the intervals of pressure, is the perceiving power? I once had the discharge of a large Leyden battery passed unexpectedly through me: I felt nothing, but was simply blotted out of conscious existence for a sensible interval. Where was

my true self during that interval? Men who have recovered from lightning-stroke have been much longer in the same state; and indeed, in cases of ordinary concussion of the brain, days may elapse during which no experience is registered in consciousness. Where is the man himself during the period of insensibility? You may say that I beg the question when I assume the man to have been unconscious, that he was really conscious all the time, and has simply forgotten what had occurred to him. In reply to this, I can only say that no one need shrink from the worst tortures that superstition ever invented if only so felt and so remembered. I do not think your theory of instruments goes at all to the bottom of the matter. A telegraph operator has his instruments, by means of which he converses with the world; our bodies possess a nervous system, which plays a similar part between the perceiving power and external things. Cut the wires of the operator, break his battery, demagnetise his needle: by this means you certainly sever his connection with the world; but, inasmuch as these are real instruments, their destruction does not touch the man who uses them. The operator survives, *and he knows that he survives.* What is it, I would ask, in the human system that answers to this conscious survival of the operator when the battery of the brain is so disturbed as to produce insensibility, or when it is destroyed altogether?

"Another consideration, which you may consider slight, presses upon me with some force. The brain may change from health to disease, and through such a change the most exemplary man may be converted into a debauchee or a murderer. My very noble and approved good master had, as you know, threatenings of lewdness introduced into his brain by his jealous wife's philter; and sooner than permit himself to run even the risk of yielding to these base promptings he slew himself. How could the hand of Lucretius have been thus turned against himself if the real Lucretius remained as before? Can the brain or can it not act in this distempered way without the intervention of the immortal reason? If it can, then it is a prime mover which requires only healthy regulation to render it reasonably self-acting, and there is no apparent need of your immortal reason at all. If it cannot, then the immortal reason, by its mischievous activity in operating upon a broken instrument, must have the credit of committing every imaginable extravagance and crime. I think, if you will allow me to say so, that the gravest consequences are likely to flow from your estimate of the body. To regard the brain as you would a staff or an eyeglass—to shut your eyes to all its mystery, to the perfect correlation that reigns between its condition and our consciousness, to the fact that a slight excess or defect of blood in it produces that very swoon to which you refer, and that in relation to it our meat and drink and air and exercise have a perfectly transcendental value and significance—to forget all this does, I think, open a way to innumerable errors in our habits of life, and may possibly in some cases initiate and foster that very disease, and consequent mental ruin, which a wiser appreciation of this mysterious organ would have avoided."

I can imagine the Bishop thoughtful after hearing this argument. He was not the man to allow anger to mingle with the consideration of a point of this kind. After due consideration, and having strengthened himself by that honest contemplation of the facts which was habitual with him, and which includes the desire to give even adverse facts their due weight, I can suppose the Bishop to proceed thus:—"You will remember that in the 'Analogy of Religion,' of which you have so kindly spoken, I did not profess to prove anything absolutely, and that I over and over again acknowledged and insisted on the smallness of our knowledge, or rather the depth of our ignorance, as regards the whole system of the universe. My object was to show my deistical friends, who set forth so eloquently the beauty and beneficence of Nature and the Ruler thereof, while they had nothing but scorn for the so-called absurdities of the Christian scheme, that they

were in no better condition than we were, and that, for every difficulty they found upon our side, quite as great a difficulty was to be found upon theirs. I will now, with your permission, adopt a similar line of argument. You are a Lucretian, and from the combination and separation of atoms deduce all terrestrial things, including organic forms and their phenomena. Let me tell you in the first instance how far I am prepared to go with you. I admit that you can build crystalline forms out of this play of molecular force; that the diamond, amethyst, and snow-star are truly wonderful structures which are thus produced. I will go further, and acknowledge that even a tree or flower might in this way be organised. Nay, if you can show me an animal without sensation, I will concede to you that it also might be put together by the suitable play of molecular force.

"Thus far our way is clear, but now comes my difficulty. Your atoms are individually without sensation, much more are they without intelligence. May I ask you, then, to try your hand upon this problem. Take your dead hydrogen atoms, your dead oxygen atoms, your dead carbon atoms, your dead nitrogen atoms, your dead phosphorus atoms, and all the other atoms, dead as grains of shot, of which the brain is formed. Imagine them separate and sensationless; observe them running together and forming all imaginable combinations. This, as a purely mechanical process, is *secable* by the mind. But can you see, or dream, or in any way imagine, how out of that mechanical act, and from these individually dead atoms, sensation, thought, and emotion are to arise? You speak of the difficulty of mental presentation in my case; is it less in yours? I am not all bereft of this *Vorstellungs-Kraft* of which you speak. I can follow a particle of musk until it reaches the olfactory nerve; I can follow the waves of sound until their tremors reach the water of the labyrinth, and set the otoliths and Corti's fibres in motion; I can also visualise the waves of ether as they cross the eye and hit the retina. Nay more, I am able to follow up to the central organ the motion thus imparted at the periphery, and to see in idea the very molecules of the brain thrown into tremors. My insight is not baffled by these physical processes. What baffles me, what I find unimaginable, transcending every faculty I possess—transcending, I humbly submit, every faculty *you* possess—is the notion that out of those physical tremors you can extract things so utterly incongruous with them as sensation, thought, and emotion. You may say, or think, that this issue of consciousness from the clash of atoms is not more incongruous than the flash of light from the union of oxygen and hydrogen. But I beg to say that it is. For such incongruity as the flash possesses is that which I now force upon your attention. The flash is an affair of consciousness, the objective counterpart of which is a vibration. It is a flash only by your interpretation. *You* are the cause of the apparent incongruity; and *you* are the thing that puzzles me. I need not remind you that the great Leibnitz felt the difficulty which I feel, and that to get rid of this monstrous deduction of life from death he displaced your atoms by his monads, which were more or less perfect mirrors of the universe, and out of the summation and integration of which he supposed all the phenomena of life—sentient, intellectual, and emotional—to arise.

"Your difficulty, then, as I see you are ready to admit, is quite as great as mine. You cannot satisfy the human understanding in its demand for logical continuity between molecular processes and the phenomena of consciousness. This is a rock on which materialism must inevitably split whenever it pretends to be a complete philosophy of life. What is the moral, my Lucretian? You and I are not likely to indulge in ill-temper in the discussion of these great topics, where we see so much room for honest differences of opinion. But there are people of less wit or more bigotry (I say it with humility) on both sides, who are ever ready to mingle anger and vituperation with such discussions. There are, for example, writers of note and

influence at the present day who are not ashamed to assume the ' deep personal sin ' of a great logician to be the cause of his unbelief in a theologic dogma. And there are others who hold that we, who cherish our noble Bible, wrought as it has been into the constitution of our forefathers, and by inheritance into us, must necessarily be hypocritical and insincere. Let us disavow and discountenance such people, cherishing the unswerving faith that what is good and true in both our arguments will be preserved for the benefit of humanity, while all that is bad or false will disappear."

It is worth remarking that in one respect the Bishop was a product of his age. Long previous to his day the nature of the soul had been so favourite and general a topic of discussion that, when the students of the University of Paris wished to know the leanings of a new Professor, they at once requested him to lecture upon the soul. About the time of Bishop Butler the question was not only agitated but extended. It was seen by the clear-witted men who entered this arena that many of their best arguments applied equally to brutes and men. The Bishop's arguments were of this character. He saw it, admitted it, accepted the consequences, and boldly embraced the whole animal world in his scheme of immortality.

Bishop Butler accepted with unwavering trust the chronology of the Old Testament, describing it as " confirmed by the natural and civil history of the world, collected from common historians, from the state of the earth, and from the late inventions of arts and sciences." These words mark progress: they must seem somewhat hoary to the Bishop's successors of to-day.* It is hardly necessary to inform you that since his time the domain of the naturalist has been immensely extended—the whole science of geology, with its astounding revelations regarding the life of the ancient earth, having been created. The rigidity of old conceptions has been relaxed, the public mind being rendered gradually tolerant of the idea that not for six thousand, nor for sixty thousand, nor for six thousand thousand, but for æons embracing untold millions of years, this earth has been the theatre of life and death. The riddle of the rocks has been read by the geologist and palæontologist, from subcambrian depths to the deposits thickening over the sea-bottoms of to-day. And upon the leaves of that stone book are, as you know, stamped the characters, plainer and surer than those formed by the ink of history, which carry the mind back into abysses of past time compared with which the periods which satisfied Bishop Butler cease to have a visual angle. Everybody now knows this ; all men admit it ; still when they were first broached these verities of science found loud-tongued denunciators, who proclaimed not only their baselessness considered scientifically, but their immorality considered as questions of ethics and religion : the Book of Genesis had stated the question in a different fashion ; and science must necessarily go to pieces when it clashed with this authority. And as the seed of the thistle produces a thistle, and nothing else, so these objectors scatter their germs abroad, and reproduce their kind, ready to play again the part of their intellectual progenitors, to show the same virulence, the same ignorance, to achieve for a time the same success, and finally to suffer the same inexorable defeat. Surely the time must come at last when human nature in its entirety, whose legitimate demands it is admitted science alone cannot satisfy, will find interpreters and expositors of a different stamp from those rash and ill-informed persons who have been hitherto so ready to hurl themselves against every new scientific revelation, lest it should endanger what they are pleased to consider theirs.

The lode of discovery once struck, those petrified forms in which life was at one time active increased to multitudes and demanded classification. The general fact soon became evident that none but the simplest forms of life lie lowest down, that as we climb higher and higher among the super-imposed strata more perfect forms appear. The change, however, from form to form was not continuous —but by steps, some small, some great. "A section," says Mr. Huxley, "a hundred feet thick will exhibit at different heights a dozen species of ammonite, none of which passes beyond its particular zone of limestone, or clay, into the zone below it, or into that above it." In the presence of such facts it was not possible to avoid the question :—Have these forms, showing, though in broken stages and with many irregularities, this unmistakable general advance, been subjected to no continuous law of growth or variation ? Had our education been purely scientific, or had it been sufficiently detached from influences which, however ennobling in another domain, have always proved hindrances and delusions when introduced as factors into the domain of physics, the scientific mind never could have swerved from the search for a law of growth, or allowed itself to accept the anthropomorphism which regarded each successive stratum as a kind of mechanic's bench for the manufacture of new species out of all relation to the old.

Biassed, however, by their previous education, the great majority of naturalists invoked a special creative act to account for the appearance of each new group of organisms. Doubtless there were numbers who were clear-headed enough to see that this was no explanation at all, that in point of fact it was an attempt, by the introduction of a greater difficulty, to account for a less. But, having nothing to offer in the way of explanation, they for the most part held their peace. Still the thoughts of reflecting men naturally and necessarily simmered round the question. De Maillet, a contemporary of Newton, has been brought into notice by Professor Huxley as one who "had a notion of the modifiability of living forms." In my frequent conversations with him, the late Sir Benjamin Brodie, a man of highly philosophic mind, often drew my attention to the fact that, as early as 1794, Charles Darwin's grandfather was the pioneer of Charles Darwin. In 1801, and in subsequent years, the celebrated Lamarck, who produced so profound an impression on the public mind through the vigorous exposition of his views by the author of the "Vestiges of Creation," endeavoured to show the development of species out of changes of habit and external condition. In 1813 Dr. Wells, the founder of our present theory of dew, read before the Royal Society a paper in which, to use the words of Mr. Darwin, " he distinctly recognises the principle of natural selection ; and this is the first recognition that has been indicated." The thoroughness and skill with which Wells pursued his work, and the obvious independence of his character, rendered him long ago a favourite with me ; and it gave me the liveliest pleasure to alight upon this additional testimony to his penetration. Professor Grant, Mr. Patrick Matthew, Von Buch, the author of the "Vestiges," D'Halloy, and others,* by the enunciation of views more or less clear and correct, showed that the question had been fermenting long prior to the year 1858, when Mr. Darwin and Mr. Wallace simultaneously, but independently, placed their closely concurrent views upon the subject before the Linnean Society.

These papers were followed in 1859 by the publication of the first edition of "The Origin of Species." All great things come slowly to the birth. Copernicus, as I informed you, pondered his great work for thirty-three years. Newton for nearly twenty years kept the idea of gravitation before his mind ; for twenty years, also, he dwelt upon his discovery of Fluxions, and doubtless would have continued to make it the object of his private thought had he not found that Leibnitz was upon his track. Darwin for

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* Only to some ; for there are dignitaries who even now speak of the earth's rocky crust as so much building material prepared for man at the Creation. Surely it is time that this loose language should cease.

* In 1855, Mr. Herbert Spencer (" Principles of Psychology," 2nd edition, vol. i., p. 465) expressed " the belief that life under all its forms has arisen by an unbroken evolution, and through the instrumentality of what are called natural causes."

two-and-twenty years pondered the problem of the origin of species, and doubtless he would have continued to do so had he not found Wallace upon his track.* A concentrated, but full and powerful, epitome of his labours was the consequence. The book was by no means an easy one; and probably not one in every score of those who then attacked it had read its pages through, or were competent to grasp their significance if they had. I do not say this merely to discredit them; for there were in those days some really eminent scientific men, entirely raised above the heat of popular prejudice, willing to accept any conclusion that science had to offer, provided it was duly backed by fact and argument, and who entirely mistook Mr. Darwin's views. In fact, the work needed an expounder; and it found one in Mr. Huxley. I know nothing more admirable in the way of scientific exposition than those early articles of his on the origin of species. He swept the curve of discussion through the really significant points of the subject, enriched his exposition with profound original remarks and reflections, often summing up in a single pithy sentence an argument which a less compact mind would have spread over pages. But there is one impression made by the book itself which no exposition of it, however luminous, can convey; and that is, the impression of the vast amount of labour, both of observation and of thought, implied in its production. Let us glance at its principles.

It is conceded on all hands that what are called varieties are continually produced. The rule is probably without exception. No chick and no child is in all respects and particulars the counterpart of its brother or sister; and in such differences we have "variety" incipient. No naturalist could tell how far this variation could be carried; but the great mass of them held that never by any amount of internal or external change, nor by the mixture of both, could the offspring of the same progenitor so far deviate from each other as to constitute different species. The function of the experimental philosopher is to combine the conditions of nature and to produce her results; and this was the method of Darwin.† He made himself acquainted with what could, without any manner of doubt, be done in the way of producing variation. He associated himself with pigeon-fanciers—bought, begged, kept, and observed every breed that he could obtain. Though derived from a common stock, the diversities of these pigeons were such that "a score of them might be chosen which, if shown to an ornithologist, and he were told that they were wild birds, would certainly be ranked by him as well-defined species." The simple principle which guides the pigeon-fancier, as it does the cattle-breeder, is the selection of some variety that strikes his fancy, and the propagation of this variety by inheritance. With his eye still upon the particular appearance which he wishes to exaggerate, he selects it as it reappears in successive broods, and thus adds increment to increment until an astonishing amount of divergence from the parent type is effected. Man in this case does not produce the *elements* of the variation. He simply observes them, and by selection adds them together until the required result has been obtained. "No man," says Mr. Darwin, "would ever try to make a fantail till he saw a pigeon with a tail developed in some slight degree in an unusual manner, or a pouter until he saw a pigeon with a crop of unusual size." Thus nature gives the hint, man acts upon it, and by the law of inheritance exaggerates the deviation.

Having thus satisfied himself by indubitable facts that the organisation of an animal or of a plant (for precisely the same treatment applies to plants) is to some extent plastic, he passes from variation under domestication to variation under nature. Hitherto we have dealt with the adding together of small changes by the conscious selec-

tion of man. Can Nature thus select? Mr. Darwin's answer is, "Assuredly she can." The number of living things produced is far in excess of the number that can be supported; hence at some period or other of their lives there must be a struggle for existence; and what is the infallible result? If one organism were a perfect copy of the other in regard to strength, skill, and agility, external conditions would decide. But this is not the case. Here we have the fact of variety offering itself to nature, as in the former instance it offered itself to man; and those varieties which are least competent to cope with surrounding conditions will infallibly give way to those that are most competent. To use a familiar proverb, the weakest comes to the wall. But the triumphant fraction again breeds to over-production, transmitting the qualities which secured its maintenance, but transmitting them in different degrees. The struggle for food again supervenes, and those to whom the favourable quality has been transmitted in excess will assuredly triumph. It is easy to see that we have here the addition of increments favourable to the individual still more rigorously carried out than in the case of domestication; for not only are unfavourable specimens not selected by nature, but they are destroyed. This is what Mr. Darwin calls "Natural Selection," which "acts by the preservation and accumulation of small inherited modifications, each profitable to the preserved being." With this idea he interpenetrates and leavens the vast store of facts that he and others have collected. We cannot, without shutting our eyes through fear or prejudice, fail to see that Darwin is here dealing, not with imaginary, but with true causes; nor can we fail to discern what vast modifications may be produced by natural selection in periods sufficiently long. Each individual increment may resemble what mathematicians call a "differential" (a quantity indefinitely small); but definite and great changes may obviously be produced by the integration of these infinitesimal quantities through practically infinite time.

If Darwin, like Bruno, rejects the notion of creative power acting after human fashion, it certainly is not because he is unacquainted with the numberless exquisite adaptations on which this notion of a supernatural artificer has been founded. His book is a repository of the most startling facts of this description. Take the marvellous observation which he cites from Dr. Crüger, where a bucket with an aperture, serving as a spout, is formed in an orchid. Bees visit the flower: in eager search of material for their combs they push each other into the bucket, the drenched ones escaping from their involuntary bath by the spout. Here they rub their backs against the viscid stigma of the flower and obtain glue; then against the pollen-masses, which are thus stuck to the back of the bee and carried away. "When the bee, thus provided, flies to another flower, or to the same flower a second time, and is pushed by its comrades into the bucket, and then crawls out by the passage, the pollen-mass upon its back necessarily comes first into contact with the viscid stigma," which takes up the pollen; and this is how that orchid is fertilised. Or take this other case of the *Catasetum*. "Bees visit these flowers in order to gnaw the labellum; on doing this they inevitably touch a long, tapering, sensitive projection. This, when touched, transmits a sensation or vibration to a certain membrane, which is instantly ruptured, setting free a spring, by which the pollen-mass is shot forth like an arrow in the right direction, and adheres by its viscid extremity to the back of the bee." In this way the fertilising pollen is spread abroad.

It is the mind thus stored with the choicest materials of the teleologist that rejects teleology, seeking to refer these wonders to natural causes. They illustrate, according to him, the method of nature, not the "technic" of a man-like Artificer. The beauty of flowers is due to natural selection. Those that distinguish themselves by vividly contrasting colours from the surrounding green leaves are most readily seen, most frequently visited by insects, most

* The behaviour of Mr. Wallace in relation to this subject has been dignified in the highest degree.

† The first step only towards experimental demonstration has been taken. Experiments now begun might, a couple of centuries hence, furnish data of incalculable value, which ought to be supplied to the science of the future.

often fertilised, and hence most favoured by natural selection. Coloured berries also readily attract the attention of birds and beasts, which feed upon them, spread their manured seeds abroad, thus giving trees and shrubs possessing such berries a greater chance in the struggle for existence.

With profound analytic and synthetic skill, Mr. Darwin investigates the cell-making instinct of the hive-bee. His method of dealing with it is representative. He falls back from the more perfectly to the less perfectly developed instinct—from the hive-bee to the humble bee, which uses its own cocoon as a comb, and to classes of bees of intermediate skill, endeavouring to show how the passage might be gradually made from the lowest to the highest. The saving of wax is the most important point in the economy of bees. Twelve to fifteen pounds of dry sugar are said to be needed for the secretion of a single pound of wax. The quantities of nectar necessary for the wax must therefore be vast; and every improvement of constructive instinct which results in the saving of wax is a direct profit to the insect's life. The time that would otherwise be devoted to the making of wax is now devoted to the gathering and storing of honey for winter food. He passes from the humble bee with its rude cells, through the Melipona with its more artistic cells, to the hive-bee with its astonishing architecture. The bees place themselves at equal distances apart upon the wax, sweep and excavate equal spheres round the selected points. The spheres intersect, and the planes of intersection are built up with thin laminæ. Hexagonal cells are thus formed. This mode of treating such questions is, as I have said, representative. He habitually retires from the more perfect and complex, to the less perfect and simple, and carries you with him through stages of *perfecting*, adds increment to increment of infinitesimal change, and in this way gradually breaks down your reluctance to admit that the exquisite climax of the whole could be a result of natural selection.

Mr. Darwin shirks no difficulty; and, saturated as the subject was with his own thought, he must have known, better than his critics, the weakness as well as the strength of his theory. This of course would be of little avail were his object a temporary dialectic victory instead of the establishment of a truth which he means to be everlasting. But he takes no pains to disguise the weakness he has discerned; nay, he takes every pains to bring it into the strongest light. His vast resources enable him to cope with objections started by himself and others, so as to leave the final impression upon the reader's mind that, if they be not completely answered, they certainly are not fatal. Their negative force being thus destroyed, you are free to be influenced by the vast positive mass of evidence he is able to bring before you. This largeness of knowledge and readiness of resource render Mr. Darwin the most terrible of antagonists. Accomplished naturalists have levelled heavy and sustained criticisms against him —not always with the view of fairly weighing his theory, but with the express intention of exposing its weak points only. This does not irritate him. He treats every objection with a soberness and thoroughness which even Bishop Butler might be proud to imitate, surrounding each fact with its appropriate detail, placing it in its proper relations, and usually giving it a significance which, as long as it was kept isolated, failed to appear. This is done without a trace of ill-temper. He moves over the subject with the passionless strength of a glacier; and the grinding of the rocks is not always without a counterpart in the logical pulverisation of the objector. But though in handling this mighty theme all passion has been stilled, there is an emotion of the intellect incident to the discernment of new truth which often colours and warms the pages of Mr. Darwin. His success has been great; and this implies not only the solidity of his work, but the preparedness of the public mind for such a revelation. On this head a remark of Agassiz impressed me more than anything else. Sprung from a race of theologians, this celebrated man combated to the last the theory of natural selection. One of the many times I had the pleasure of meeting him in the United States was at Mr. Winthrop's beautiful residence at Brookline, near Boston. Rising from luncheon, we all halted as if by a common impulse in front of a window, and continued there a discussion which had been started at table. The maple was in its autumn glory; and the exquisite beauty of the scene outside seemed, in my case, to interpenetrate without disturbance the intellectual action. Earnestly, almost sadly, Agassiz turned, and said to the gentlemen standing round, "I confess that I was not prepared to see this theory received as it has been by the best intellects of our time. Its success is greater than I could have thought possible."

In our day great generalisations have been reached. The theory of the origin of species is but one of them. Another, of still wider grasp and more radical significance, is the doctrine of the Conservation of Energy, the ultimate philosophical issues of which are as yet but dimly seen— that doctrine which "binds nature fast in fate" to an extent not hitherto recognised, exacting from every antecedent its equivalent consequent, from every consequent its equivalent antecedent, and bringing vital as well as physical phenomena under the dominion of that law of causal connection which, as far as the human understanding has yet pierced, asserts itself everywhere in nature. Long in advance of all definite experiment upon the subject, the constancy and indestructibility of matter had been affirmed; and all subsequent experience justified the affirmation. Later researches extended the attribute of indestructibility to force. This idea, applied in the first instance to inorganic, rapidly embraced organic nature. The vegetable world, though drawing almost all its nutriment from invisible sources, was proved incompetent to generate anew either matter or force. Its matter is for the most part transmuted air; its force transformed solar force. The animal world was proved to be equally uncreative, all its motive energies being referred to the combustion of its food. The activity of each animal as a whole was proved to be the transferred activities of its molecules. The muscles were shown to be stores of mechanical force, potential until unlocked by the nerves, and then resulting in muscular contractions. The speed at which messages fly to and fro along the nerves was determined, and found to be, not as had been previously supposed, equal to that of light or electricity, but less than the speed of a flying eagle.

This was the work of the physicist: then came the conquests of the comparative anatomist and physiologist, revealing the structure of every animal, and the function of every organ in the whole biological series, from the lowest zoophyte up to man. The nervous system had been made the object of profound and continued study, the wonderful and, at bottom, entirely mysterious, controlling power which it exercises over the whole organism, physical and mental, being recognised more and more. Thought could not be kept back from a subject so profoundly suggestive. Besides the physical life dealt with by Mr. Darwin, there is a psychical life presenting similar gradations, and asking equally for a solution. How are the different grades and orders of Mind to be accounted for? What is the principle of growth of that mysterious power which on our planet culminates in reason? These are questions which, though not thrusting themselves so forcibly upon the attention of the general public, had not only occupied many reflecting minds, but had been formally broached by one of them before the "Origin of Species" appeared.

With the mass of materials furnished by the physicist and physiologist in his hands, Mr. Herbert Spencer, twenty years ago, sought to graft upon this basis a system of psychology; and two years ago a second and greatly amplified edition of his work appeared. Those who have occupied themselves with the beautiful experiments of Plateau will remember that when two spherules of olive-

oil, suspended in a mixture of alcohol and water of the same density of the oil, are brought together, they do not immediately unite. Something like a pellicle appears to be formed around the drops, the rupture of which is immediately followed by the coalescence of the globules into one. There are organisms whose vital actions are almost as purely physical as that of these drops of oil. They come into contact and fuse themselves thus together. From such organisms to other a shade higher, and from these to others a shade higher still, and on through an ever ascending series, Mr. Spencer conducts his argument. There are two obvious factors to be here taken into account—the creature and the medium in which it lives, or, as it is often expressed, the organism and its environment. Mr. Spencer's fundamental principle is, that between these two factors there is incessant interaction. The organism is played upon by the environment, and is modified to meet the requirements of the environment. Life he defines to be " a continuous adjustment of internal relations to external relations."

In the lowest organisms we have a kind of tactual sense diffused over the entire body; then, through impressions from without and their corresponding adjustments, special portions of the surface become more responsive to stimuli than others. The senses are nascent, the basis of all of them being that simple tactual sense which the sage Democritus recognised 2300 years ago as their common progenitor. The action of light, in the first instance, appears to be a mere disturbance of the chemical processes in the animal organism, similar to that which occurs in the leaves of plants. By degrees the action becomes localised in a few pigment-cells, more sensitive to light than the surrounding tissue. The eye is here incipient. At first it is merely capable of revealing differences of light and shade produced by bodies close at hand. Followed as the interception of the light is, in almost all cases, by the contact of the closely adjacent opaque body, sight in this condition becomes a kind of " anticipatory touch." The adjustment continues ; a slight bulging out of the epidermis over the pigment-granules supervenes. A lens is incipient, and, through the operation of infinite adjustments, at length reaches the perfection that it displays in the hawk and eagle. So of the other senses ; they are special differentiations of a tissue which was originally vaguely sensitive all over.

With the development of the senses the adjustments between the organism and its environment gradually extend in *space*, a multiplication of experiences and a corresponding modification of conduct being the result. The adjustments also extend in *time*, covering continually greater intervals. Along with this extension in space and time the adjustments also increase in speciality and complexity, passing through the various grades of brute life, and prolonging themselves into the domain of reason. Very striking are Mr. Spencer's remarks regarding the influence of the sense of touch upon the development of intelligence. This is, so to say, the mother-tongue of all the senses, into which they must be translated to be of service to the organism. Hence its importance. The parrot is the most intelligent of birds, and its tactual power is also greatest. From this sense it gets knowledge unattainable by birds which cannot employ their feet as hands. The elephant is the most sagacious of quadrupeds,—its tactual range and skill, and the consequent multiplication of experiences, which it owes to its wonderfully adaptable trunk, being the basis of its sagacity. Feline animals, for a similar cause, are more sagacious than hoofed animals,—atonement being to some extent made, in the case of the horse, by the possession of sensitive prehensile lips. In the *Primates* the evolution of intellect and the evolution of tactual appendages go hand in hand. In the most intelligent anthropoid apes we find the tactual range and delicacy greatly augmented, new avenues of knowledge being thus opened to the animal. Man crowns the edifice here, not only in virtue of his own manipulatory power, but through the enormous

extension of his range of experience, by the invention of instruments of precision, which serve as supplemental senses and supplemental limbs. The reciprocal action of these is finely described and illustrated. That chastened intellectual emotion to which I have referred in connection with Mr. Darwin is, I should say, not absent in Mr. Spencer. His illustrations possess at times exceeding vividness and force; and from his style on such occasions it is to be inferred that the ganglia of this Apostle of the Understanding are sometimes the seat of a nascent poetic thrill.

It is a fact of supreme importance that actions the performance of which at first requires even painful effort and deliberation, may by habit be rendered automatic. Witness the slow learning of its letters by a child, and the subsequent facility of reading in a man, when each group of letters which forms a word is instantly, and without effort, fused to a single perception. Instance the billiard-player, whose muscles of hand and eye, when he reaches the perfection of his art, are unconsciously co-ordinated. Instance the musician, who, by practice, is enabled to fuse a multitude of arrangements, auditory, tactual, and muscular, into a process of automatic manipulation. Combining such facts with the doctrine of hereditary transmission, we reach a theory of Instinct. A chick, after coming out of the egg, balances itself correctly, runs about, picks up food, thus showing that it possesses a power of directing its movements to definite ends. How did the chick learn this very complex co-ordination of eye, muscles, and beak ? It has not been individually taught ; its personal experience is *nil*; but it has the benefit of ancestral experience. In its inherited organisation are registered all the powers which it displays at birth. So also as regards the instinct of the hive-bee, already referred to. The distance at which the insects stand apart when they sweep their hemispheres and build their cells is " organically remembered." Man also carries with him the physical texture of his ancestry, as well as the inherited intellect bound up with it. The defects of intelligence during infancy and youth are probably less due to a lack of individual experience than to the fact that in early life the cerebral organisation is still incomplete. The period necessary for completion varies with the race, and with the individual. As a round shot outstrips a rifled one on quitting the muzzle of the gun, so the lower race in childhood may outstrip the higher. But the higher eventually overtakes the lower, and surpasses it in range. As regards individuals, we do not always find the precocity of youth prolonged to mental power in maturity ; while the dulness of boyhood is sometimes strikingly contrasted with the intellectual energy of after years. Newton, when a boy, was weakly, and he showed no particular aptitude at school ; but in his eighteenth year he went to Cambridge, and soon afterwards astonished his teachers by his power of dealing with geometrical problems. During his quiet youth his brain was slowly preparing itself to be the organ of those energies which he subsequently displayed.

By myriad blows (to use a Lucretian phrase) the image and superscription of the external world are stamped as states of consciousness upon the organism, the depth of the impression depending upon the number of the blows. When two or more phenomena occur in the environment invariably together, they are stamped to the same depth or to the same relief, and indissolubly connected. And here we come to the threshold of a great question. Seeing that he could in no way rid himself of the consciousness of Space and Time, Kant assumed them to be necessary " forms of thought," the moulds and shapes into which our intuitions are thrown belonging to ourselves solely, and without objective existence. With unexpected power and success Mr. Spencer brings the hereditary experience theory, as he holds it, to bear upon this question. " If there exist certain external relations which are experienced by all organisms at all instants of their waking lives—relations which are absolutely constant and universal—there will be established answering internal rela-

tions that are absolutely constant and universal. Such relations we have in those of Space and Time. As the substratum of all other relations of the Non-Ego, they must be responded to by conceptions that are the sub-strata of all other relations in the Ego. Being the constant and infinitely repeated elements of thought, they must become the automatic elements of thought,—the elements of thought which it is impossible to get rid of,—the 'forms of intuition.' "

Throughout this application and extension of the " Law of Inseparable Association," Mr. Spencer stands on totally different ground from Mr. John Stuart Mill, invoking the registered experiences of the race instead of the experiences of the individual. His overthrow of Mr. Mill's restriction of experience is, I think, complete. That restriction ignores the power of organising experience furnished at the outset to each individual; it ignores the different degrees of this power possessed by different races and by different individuals of the same race. Were there not in the human brain a potency antecedent to all experience, a dog or cat ought to be as capable of education as a man. These predetermined internal relations are independent of the experiences of the individual. The human brain is the " organised register of infinitely numerous experiences received during the evolution of life, or rather during the evolution of that series of organisms through which the human organism has been reached. The effects of the most uniform and frequent of these experiences have been successively bequeathed, principal and interest, and have slowly mounted to that high intelligence which lies latent in the brain of the infant. Thus it happens that the European inherits from 20 to 30 cubic inches more of brain than the Papuan. Thus it happens that faculties, as of music, which scarcely exist in some inferior races, become congenital in superior ones. Thus it happens that out of savages unable to count up to the nnmber of their fingers, and speaking a language containing only nouns and verbs, arise at length our Newtons and Shakspeares."

At the outset of this Address it was stated that physical theories which lie beyond experience are derived by a process of abstraction from experience. It is instructive to note from this point of view the successive introduction of new conceptions. The idea of the attraction of gravitation was preceded by the observation of the attraction of iron by a magnet, and of light bodies by rubbed amber. The polarity of magnetism and electricity appealed to the senses; and thus became the substratum of the conception that atoms and molecules are endowed with definite, attractive and repellent poles, by the play of which definite forms of crystalline architecture are produced. Thus molecular force becomes *structural*. It required no great boldness of thought to extend its play into organic nature, and to recognise in molecular force the agency by which both plants and animals are built up. In this way out of experience arise conceptions which are wholly ultra-experiential.

The *origination* of life is a point lightly touched upon, if at all, by Mr. Darwin and Mr. Spencer. Diminishing gradually the number of progenitors, Mr. Darwin comes at length to one " primordial form; " but he does not say, as far as I remember, how he supposes this form to have been introduced. He quotes with satisfaction the words of a celebrated author and divine who had " gradually learnt to see that it is just as noble a conception of the Deity to believe He created a few original forms, capable of self-development into other and needful forms, as to believe that He required a fresh act of creation to supply the voids caused by the action of His laws." What Mr. Darwin thinks of this view of the introduction of life I do not know. Whether he does or does not introduce his " primordial form " by a creative act, I do not know. But the question will inevitably be asked, " How came the form there ? " With regard to the diminution of the number of created forms, one does not see that much advantage is gained by it. The

anthropomorphism, which it seemed the object of Mr. Darwin to set aside, is as firmly associated with the creation of a few forms as with the creation of a multitude. We need clearness and thoroughness here. Two courses, and two only, are possible. Either let us open our doors freely to the conception of creative acts, or, abandoning them, let us radically change our notions of Matter. If we look at matter as pictured by Democritus, and as defined for generations in our scientific text-books, the absolute impossibility of any form of life coming out of it would be sufficient to render any other hypothesis preferable; but the definitions of matter given in our text-books were intended to cover its purely physical and mechanical properties. And taught as we have been to regard these definitions as complete, we naturally and rightly reject the monstrous notion that out of *such* matter any form of life could possibly arise. But are the definitions complete ? Everything depends on the answer to be given to this question. Trace the line of life backwards, and see it approaching more and more to what we call the purely physical condition. We reach at length those organisms which I have compared to drops of oil suspended in a mixture of alcohol and water. We reach the *protogenes* of Haeckel, in which we have "a type distinguishable from a fragment of albumen only by its finely granular character." Can we pause here ? We break a magnet, and find two poles in each of its fragments. We continue the process of breaking, but however small the parts each carries with it, though enfeebled, the polarity of the whole. And when we can break no longer, we prolong the intellectual vision to the polar molecules. Are we not urged to do *something* similar in the case of life ? Is there not a temptation to close to some extent with Lucretius, when he affirms that " Nature is seen to do all things spontaneously of herself without the meddling of the gods ? " or with Bruno, when he declares that Matter is not "that mere empty *capacity* which philosophers have pictured her to be, but the universal mother who brings forth all things as the fruit of her own womb ? " The questions here raised are inevitable. They are approaching us with accelerated speed, and it is not a matter of indifference whether they are introduced with reverence or with irreverence. Abandoning all disguise, the confession that I feel bound to make before you is that I prolong the vision backward across the boundary of the experimental evidence, and discern in that Matter which we in our ignorance—and notwithstanding our professed reverence for its Creator—have hitherto covered with opprobrium, the promise and potency of every form and quality of Life.

The " materialism " here enunciated may be different from what you suppose, and I therefore crave your gracious patience to the end. " The question of an external world," says Mr. J. S. Mill, " is the great battle-ground of metaphysics."* Mr. Mill himself reduces external phenomena to " possibilities of sensation." Kant, as we have seen, made time and space " forms " of our own intuitions. Fichte, having first by the inexorable logic of his understanding proved himself to be a mere link in that chain of eternal causation which holds so rigidly in nature, violently broke the chain by making nature, and all that it inherits, an apparition of his own mind.† And it is by no means easy to combat such notions. For when I say I see you, and that I have not the least doubt about it, the reply is, that what I am really conscious of is an affection of my own retina. And if I urge that I can check my sight of you by touching you, the retort would be that I am equally transgressing the limits of fact; for what I am really conscious of is, not that you are there, but that the nerves of my hand have undergone a change. All we hear, and see, and touch, and taste, and smell, are, it would be urged, mere variations of our own condition, beyond which, even to the extent of a hair's breadth, we cannot go. That anything answering to our impressions

* " Examination of Hamilton," p. 154.
† " Bestimmung des Menschen."

exists outside of ourselves is not a *fact*, but an *inference*, to which all validity would be denied by an idealist like Berkeley, or by a sceptic like Hume. Mr. Spencer takes another line. With him, as with the uneducated man, there is no doubt or question as to the existence of an external world. But he differs from the uneducated, who think that the world really *is* what consciousness represents it to be. Our states of consciousness are mere *symbols* of an outside entity which produces them and determines the order of their succession, but the real nature of which we can never know.* In fact, the whole process of evolution is the manifestation of a Power absolutely inscrutable to the intellect of man. As little in our day as in the days of Job can man by searching find this Power out. Considered fundamentally, it is by the operation of an insoluble mystery that life is evolved, species differentiated, and mind unfolded from their prepotent elements in the immeasurable past. There is, you will observe, no very rank materialism here.

The strength of the doctrine of evolution consists, not in an experimental demonstration (for the subject is hardly accessible to this mode of proof), but in its general harmony with the method of nature as hitherto known. From contrast, moreover, it derives enormous relative strength. On the one side we have a theory (if it could with any propriety be so called) derived, as were the theories referred to at the beginning of this Address, not from the study of nature, but from the observation of men —a theory which converts the Power whose garment is seen in the visible universe into an Artificer, fashioned after the human model, and acting by broken efforts as man is seen to act. On the other side we have the conception that all we see around us, and all we feel within us—the phenomena of physical nature as well as those of the human mind—have their unsearchable roots in a cosmical life, if I dare apply the term, an infinitesimal span of which only is offered to the investigation of man. And even this span is only knowable in part. We can trace the development of a nervous system, and correlate with it the parallel phenomena of sensation and thought. We see with undoubting certainty that they go hand in hand. But we try to soar in a vacuum the moment we seek to comprehend the connection between them. An Archimedean fulcrum is here required which the human mind cannot command; and the effort to solve the problem, to borrow an illustration from an illustrious friend of mine, is like the effort of a man trying to lift himself by his own waistband. All that has been here said is to be taken in connection with this fundamental truth. When "nascent senses" are spoken of, when "the differentiation of a tissue at first vaguely sensitive all over is spoken of," and when these processes are associated with "the modification of an organism by its environment," the same parallelism, without contact, or even approach to contact, is implied. There is no fusion possible between the two classes of facts—no motor energy in the intellect of man to carry it without logical rupture from the one to the other.

Further, the doctrine of evolution derives man, in his totality, from the inter-action of organism and environment through countless ages past. The human understanding, for example—that faculty which Mr. Spencer has turned so skilfully round upon its own antecedents—is itself a result of the play between organism and environment

* In a paper, at once popular and profound, entitled "Recent Progress in the Theory of Vision," contained in the volume of Lectures by Helmholtz, published by Longmans, this symbolism of our states of consciousness is also dwelt upon. The impressions of sense are the mere *signs* of external things. In this paper Helmholtz contends strongly against the view that the consciousness of space is inborn; and he evidently doubts the power of the chick to pick up grains of corn without some preliminary lessons. On this point, he says, further experiments are needed. Such experiments have been since made by Mr. Spalding, aided, I believe, in some of his observations by the accomplished and deeply lamented Lady Amberly; and they seem to prove conclusively that the chick does not need a single moment's tuition to teach it to stand, run, govern the muscles of its eyes, and peck. Helmholtz, however, is contending against the notion of pre-established harmony; and I am not aware of his views as to the organisation of experiences of race or breed.

through cosmic ranges of time. Never, surely, did prescription plead so irresistible a claim. But then it comes to pass that, over and above his understanding, there are many other things appertaining to man whose prescriptive rights are quite as strong as that of the understanding itself. It is a result, for example, of the play of organism and environment that sugar is sweet and that aloes are bitter, that the smell of henbane differs from the perfume of a rose. Such facts of consciousness (for which, by the way, no adequate reason has ever yet been rendered) are quite as old as the understanding itself; and many other things can boast an equally ancient origin. Mr. Spencer at one place refers to that most powerful of passions—the amatory passion—as one which, when it first occurs, is antecedent to all relative experience whatever; and we may pass its claim as being at least as ancient and as valid as that of the understanding itself. Then there are such things woven into the texture of man as the feeling of awe, reverence, wonder,—and not alone the sexual love just referred to, but the love of the beautiful, physical and moral, in Nature, poetry, and art. There is also that deep-set feeling which, since the earliest dawn of history, and probably for ages prior to all history, incorporated itself in the Religions of the world. You who have escaped from these religions into the high-and-dry light of the understanding may deride them; but in so doing you deride accidents of form merely, and fail to touch the immovable basis of the religious sentiment in the emotional nature of man. To yield to this sentiment reasonable satisfaction is the problem of problems at the present hour. And grotesque in relation to scientific culture as many of the religions of the world have been and are—dangerous, nay destructive, to the dearest privileges of freemen as some of them undoubtedly have been, and would, if they could, be again,—it will be wise to recognise them as the forms of a force, mischievous if permitted to intrude on the region of *knowledge*, over which it holds no command, but capable of being guided by liberal thought to noble issues in the region of *emotion*, which is its proper sphere. It is vain to oppose this force with a view to its extirpation. What we should oppose, to the death if necessary, is every attempt to found upon this elemental bias of man's nature a system which should exercise despotic sway over his intellect. I do not fear any such consummation. Science has already to some extent leavened the world, and it will leaven it more and more. I should look upon the mild light of science breaking in upon the minds of the youth of Ireland, and strengthening gradually to the perfect day, as a surer check to any intellectual or spiritual tyranny which might threaten this island, than the laws of princes or the swords of emperors. Where is the cause of fear? We fought and won our battle even in the Middle Ages: why should we doubt the issue of a conflict now?

The impregnable position of science may be described in a few words. All religious theories, schemes, and systems, which embrace notions of cosmogony, or which otherwise reach into its domain, must, in so far as they do this, submit to the control of science, and relinquish all thought of controlling it. Acting otherwise proved disastrous in the past, and it is simply fatuous to-day. Every system which would escape the fate of an organism too rigid to adjust itself to its environment, must be plastic to the extent that the growth of knowledge demands. When this truth has been thoroughly taken in, rigidity will be relaxed, exclusiveness diminished, things now deemed essential will be dropped, and elements now rejected will be assimilated. The lifting of the life is the essential point; and, as long as dogmatism, fanaticism, and intolerance are kept out, various modes of leverage may be employed to raise life to a higher level. Science itself not unfrequently derives motive power from an ultra-scientific source. Whewell speaks of enthusiasm of temper as a hindrance to science; but he means the enthusiasm of weak heads. There is a strong and resolute enthusiasm in which science finds an ally; and it is to the

lowering of this fire, rather than to a diminution of intellectual insight, that the lessening productiveness of men of science in their mature years is to be ascribed. Mr. Buckle sought to detach intellectual achievement from moral force. He gravely erred; for without moral force to whip it into action, the achievements of the intellect would be poor indeed.

It has been said that science divorces itself from literature: the statement, like so many others, arises from lack of knowledge. A glance at the less technical writings of its leaders—of its Helmholtz, its Huxley, and its Du Bois-Reymond—would show what breadth of literary culture they command. Where among modern writers can you find their superiors in clearness, and vigour of literary style? Science desires not isolation, but freely combines with every effort towards the bettering of man's estate. Single-handed, and supported not by outward sympathy, but by inward force, it has built at least one great wing of the many-mansioned home which man in his totality demands. And, if rough walls and protruding rafter-ends indicate that on one side the edifice is still incomplete, it is only by wise combination of the parts required, with those already irrevocably built, that we can hope for completeness. There is no necessary incongruity between what has been accomplished and what remains to be done. The moral glow of Socrates, which we all feel by ignition, has in it nothing incompatible with the physics of Anaxagoras which he so much scorned, but which he would hardly scorn to-day. And here I am reminded of one amongst us, hoary, but still strong, whose prophet-voice some thirty years ago, far more than any other of this age, unlocked whatever of life and nobleness lay latent in its most gifted minds—one fit to stand beside Socrates or the Maccabean Eleazar, and to dare and suffer all that they suffered and dared—fit, as he once said of Fichte, "to have been the teacher of the Stoa, and to have discoursed of Beauty and Virtue in the groves of Academe." With a capacity to grasp physical principles which his friend Goethe did not possess, and which even total lack of exercise has not been able to reduce to atropy, it is the world's loss that he, in the vigour of his years, did not open his mind and sympathies to science, and make his conclusions a portion of his message to mankind. Marvellously endowed as he was—equally equipped on the side of the heart and of the understanding—he might have done much towards teaching us how to reconcile the claims of both, and to enable them in coming times to dwell together in unity of spirit and in the bond of peace.

And now the end is come. With more time, or greater strength and knowledge, what has been here said might have been better said, while worthy matters here omitted might have received fit expression. But there would have been no material deviation from the views set forth. As regards myself, they are not the growth of a day; and as regards you, I thought you ought to know the environment which, with or without your consent, is rapidly surrounding you, and in relation to which some adjustment on your part may be necessary. A hint of Hamlet's, however, teaches us all how the troubles of common life may be ended; and it is perfectly possible for you and me to purchase intellectual peace at the price of intellectual death. The world is not without refuges of this description: nor is it wanting in persons who seek their shelter and try to persuade others to do the same. I would exhort you to refuse such shelter, and to scorn such base repose—to accept, if the choice be forced upon you, commotion before stagnation, the leap of the torrent before the stillness of the swamp. In the one there is at all events life and, therefore, hope; in the other none. I have touched on debatable questions, and led you over dangerous ground—and this partly with the view of telling you, and through you the world, that as regards these questions science claims unrestricted right of search. It is not to the point to say that the views of Lucretius and Bruno, of Darwin and Spencer, may be wrong. I concede the possibility, deeming it indeed certain that

these views will undergo modification. But the point is, that whether right or wrong, we claim the freedom to discuss them. The ground which they cover is scientific ground; and the right claimed is one made good through tribulation and anguish, inflicted and endured in darker times than ours, but resulting in the immortal victories which science has won for the human race. I would set forth equally the inexorable advance of man's understanding in the path of knowledge, and the unquenchable claims of his emotional nature which the understanding can never satisfy. The world embraces not only a Newton, but a Shakspeare—not only a Boyle, but a Raphael—not only a Kant, but a Beethoven—not only a Darwin, but a Carlyle. Not in each of these, but in all, is human nature whole. They are not opposed, but supplementary—not mutually exclusive, but reconcilable. And if, still unsatisfied, the human mind, with the yearning of a pilgrim for his distant home, will turn to the Mystery from which it has emerged, seeking so to fashion it as to give unity to thought and faith, so long as this is done, not only without intolerance or bigotry of any kind, but with the enlightened recognition that ultimate fixity of conception is here unattainable, and that each succeeding age must be held free to fashion the mystery in accordance with its own needs—then, in opposition to all the restrictions of Materialism, I would affirm this to be a field for the noblest exercise of what, in contrast with the *knowing* faculties, may be called the *creative* faculties of man. Here, however, I must quit a theme too great for me to handle, but which will be handled by the loftiest minds ages after you and I, like streaks of morning cloud, shall have melted into the infinite azure of the past.

Section B.

ADDRESS

TO THE

CHEMICAL SECTION.

AUGUST 20, 1874.

By A. CRUM BROWN, M.D., F.R.S.E., &c.,
President of the Section.

GENTLEMEN,—

One hundred years have elapsed since the discovery of oxygen by Priestley. Perhaps we should say re-discovery, for there is no doubt that about one hundred years earlier Mayow prepared from nitre nearly pure oxygen, and observed and recorded some of its most marked properties. Mayow's discovery, however, led to nothing; while Priestley's was the most important step in that re-construction of speculative chemistry which was commenced by Black and carried on with surprising energy and thoroughness by Lavoisier and his associates. I shall not detain you by enumerating the ways in which this discovery has affected chemistry, both practical and speculative. The pre-eminent position to which oxygen was at once elevated, and which it so long retained, makes this altogether unnecessary. I wish, however, to point out one character of the phlogistic controversy, which sharply distinguishes it from many others. The truth represented by the theory of Phlogiston was not recognised with sufficient distinctness by the supporters of that theory to give them any chance of success in opposition to a band of devoted adherents of a view which was clearly understood by all. The Phlogistists were completely defeated, and the theory ceased to exist. It has been left for chemical antiquaries to pick out, with difficulty and uncertainty, a meaning from the ruins.

I have mentioned this character because I wish to draw your attention to another, more recent, controversy, the result of which was very different.

The questions as to chemical constitution, raised about

forty years ago by Dumas and the new French school in opposition to Berzelius, may now be said to be practically settled. The great majority of chemists are agreed as to what is to be understood by chemical constitution, and also as to the nature and amount of evidence required in order to determine the constitution of a substance. How has this agreement been produced? Some historical writers seem to wish us to believe that it is the result of the triumph of the ideas of Dumas, Gerhardt, and Laurent, and the defeat of the dualistic radical theory of Berzelius; that the arguments of Berzelius and his followers were only useful as giving occasion for a more full and convincing proof of the unitary substitution theory than would otherwise have been called for; that, in fact, the adherents of dualism played the part (not unfrequently supposed to be that of the conservative party in politics) of checking and criticising the successive developments of truth, and thus allowing them time to ripen.

In opposition to the view thus broadly stated, I would place another, and, for the sake of contrast, shall state it also in perhaps too broad a form. That the two theories—the dualistic radical theory and the unitary substitution theory—were both true and both imperfect; that they underwent gradual development, scarcely influenced by each other, until they have come to be almost identical in reference to points where they at one time seemed most opposed.

I have said that the development of the one theory was scarcely influenced by that of the other. Of course, the *facts* discovered by both parties were common property, and the development of both theories depended upon the discovery of these facts; but the explanations of facts, and the reasoning from them given by each party, seemed to the other scarcely worthy of serious consideration, and were treated as matter of ridicule. And the habit of mind created by this mode of viewing the opposed theory has rendered it difficult for those who were engaged in the controversy on either side to see how nearly the two theories have now come to coincidence. Their language still remains different; but, as the facts are the same for both, it is not difficult for a neutral critic to translate from the one to the other, and if we do so we shall see that there is much real agreement between the two modes of representing chemical ideas, historically derived, the one from Berzelius, the other from Dumas, Laurent, and Gerhardt.

In both, chemical constitution is regarded as *the order in which the constituents are united in the compound*, and the same fundamental notion is indicated in the one by reference to proximate constituents, in the other by the concatenation of atoms. To show that this is so, and that the fundamental notion can be arrived at from the dualistic, as well as from the unitary starting-point, I shall cite an illustrative case. Every student of chemical history will remember the view of the constitution of trichloracetic acid propounded by Berzelius, and afterwards supplemented by a similar view of the constitution of acetic acid, and an explanation of the likeness of some of the properties of these two substances. This has sometimes been spoken of as a subterfuge of a not very creditable kind, by means of which Berzelius apparently saved his consistency while really yielding to the arguments of his opponents. But if, instead of looking at it in the light of the substitution controversy, we consider it in itself as a contribution to speculative chemistry, we at once recognise in it a statement, in Berzelian language, of the views we now hold as to the constitution of these acids. The view was that acetic acid is a compound of oxalic acid and methyl, trichloracetic acid a compound of oxalic acid and the sesquichloride of carbon. They differ considerably from each other, because the "copulæ" (methyl and sesquichloride of carbon respectively) are different, but their resemblance is strongly marked, because they contain the same active constituent, oxalic acid, and most of the prominent characters of the substances depend upon it, and not upon the copula. Let us first free this statement

from what we may call archaisms of language. It will then assume something like the following form:—The carbon in acetic acid is equally divided between two proximate constituents, one of which is an oxide, the other a hydride of carbon; trichloracetic acid similarly contains an oxide and a chloride of carbon, between which the carbon is equally divided. The oxide is the same in both acids, and is that oxide which occurs in oxalic acid. The hydride and the chloride have the composition of the substances the formulæ of which are C_2H_6 and C_2Cl_6 respectively. Oxalic acid undergoes chemical change much more readily than the corresponding hydride or chloride, and therefore the chemical character of acetic and of trichloracetic acids depends much more on the oxidised than on the other constituent, and they thus have a marked resemblance. The oxidised constituent is united to the other in a manner different from that in which oxalic acid is united to bases in the oxalates, inasmuch as, while the basic water of hydrated oxalic acid is displaced when oxalic acid unites with a base, in hydrated acetic and trichloracetic acids there is the same proportion between the basic water and the oxidised carbon as there is in oxalic acid.

Now has not this a great resemblance to the view entertained by most modern chemists, that acetic acid is a compound of the radical carboxyl (half a molecule of oxalic acid) and the radical methyl (half a molecule of methyl gas), that trichloracetic acid similarly contains the same radical carboxyl and the radical CCl_3, and that the prominent chemical properties of these bodies depend upon their containing carboxyl, and that they therefore resemble each other?

The modern view contains nothing inconsistent with that of Berzelius, but it no doubt contains something more,—it contains an explanation of the difference between the manner in which carboxyl is united to methyl in acetic acid, and the manner in which oxalic acid is united to bases in the oxalates; but it will surely be admitted that Berzelius was here far ahead of his opponents, —so far ahead that they altogether failed to see his meaning, and looked upon his argument as a clumsy device.

The treatment by Berzelius of the constitution of the sulpho-acids furnishes a precisely similar case. These are now considered as compounds of the radical SO_2OH (which we may call sulphoxyl). This radical is half a molecule of hyposulphuric acid, and Berzelius considered them as coupled compounds of hyposulphuric acid, adopting at once the view first brought forward by Kolbe, in his classical memoir on the sulphite of perchloride of carbon, and the acids derived from it.

I might pursue the history of the carbon- and sulpho-acids further, and trace the development of the theory of their constitution through the discoveries of Kolbe and his beautiful application to the cases of carbon and sulphur of Frankland's far-sighted speculation on the constitution of the organo-metallic bodies,—pointing out the relation of Kolbe's views of the constitution of acids, alcohols, aldehydes, and ketones, to the Berzelian theory on the one hand, and to the opinions of modern chemists on the other; but the greater part of such a historical sketch has been given very recently by Kolbe himself, in the *Journal für Praktische Chemie*, and I may therefore omit it.

It would be easy to bring forward cases to show that our present views can be directly derived from the substitution theory and the types of Dumas and Gerhardt, through the complications of multiple and mixed types and the labyrinthine formulæ to which these gave rise, to the wonderfully simple and comprehensive system of Kekulé; but that is unnecessary, as this development has been fully and ably described by more than one thoroughly competent writer.

We have been discussing a case in which Berzelius was right in considering a compound of carbon, oxygen, and chlorine as composed of two parts—an oxide and a

chloride of carbon. It is only just that we should take some notice of cases, at first sight similar, in which modern chemists would be inclined to think that he was wrong. This is the more necessary as an examination of these cases will enable us to see what was the really valuable contribution made to speculative chemistry by the substitution theory.

Compounds containing three elements were formulated in two different ways by Berzelius:—1. One of the elements was represented as combined with a radical composed of the other two,—as hydrocyanic acid, $H_2.C_2N_2$; ether, $C_4H_{10}.O$. 2. The ternary compound was represented as composed of two binary compounds having one element common,—as caustic potash, $KO.H_2O$; chromochloric acid, $2CrO_3.CrCl_6$.

Phosgene gas was at first formulated in the former of these ways as $CO.Cl_2$; but latterly he was forced in consistency to give up all radicals containing oxygen or other strongly electro-negative element,* and to write the formula of phosgene gas $CO_2.CCl_4$. Similarly, in every case where a positive element or radical is combined with two negative elements or radicals, he represented the compound as composed of two binary compounds. Thus —chloride of acetyl, $2C_4H_6O_3.C_4H_6Cl_6$, as a compound of acetic acid and the corresponding terchloride.

This was in perfect consistency with the mode in which ternary compounds containing one negative and two positive elements or radicals were formulated,—as caustic potash, $KO.H_2O$; sulphate of copper, $CuO.SO_3$, &c., but it lacks the practical justification which can be given for the formula $C_2H_6.C_2O_3$ for acetic acid. For phosgene acts readily on water, forming carbonic and hydrochloric acids, an action which does not take place with perchloride of carbon, and it is not easy to see why the latter substance should be more readily attacked by water when combined with carbonic acid than when free. This difference did not escape the attention of Berzelius, and led him to distinguish two modes of chemical union:— 1. Where the constituents were held together by the electro-chemical force, and wholly or partially neutralised each other, as in the oxygen and sulphur salts; and 2. Where a so-called "copula" was attached by an unknown force to a substance without greatly modifying its chemical activity. The distinction seems arbitrary; but it was not, as is usually supposed, a mere artificial bulwark to protect the electro-chemical theory; it has a real and very important meaning—a meaning which the development of the substitution theory enables us to explain.

The phenomena of electrolysis, upon which the Berzelian system is based, bring forward into great prominence *one* of the chemical units, viz., the *equivalent*, and the pre-eminent position of oxygen as the most electro-negative element made it most natural to select the atom of oxygen as the standard of equivalence, so that an equivalent of any element or radical was defined as that quantity of it which was equivalent to one atom of oxygen. Gay Lussac's law of gaseous volumes, which was adopted by Berzelius, and which, by a curious accident, happens to be true for all elements gaseous at ordinary temperatures, led to the formulæ H_2 and Cl_2 for the equivalents of hydrogen and chlorine; but although these formulæ explicitly indicate the divisibility of the equivalents of these elements, this divisibility was not recognised, and integral numbers of equivalents were alone tolerated. Thus hydrochloric acid was written H_2Cl_2, ammonia N_2H_6, &c., and the etymological meaning of the word "atom" was soon lost. The use of barred letters, to indicate two atoms, or one equivalent of such elements as hydrogen and chlorine, further contributed to hide the important fact of their divisibility.

The first great result of the substitution theory was to change the unit of equivalence, and to take as the standard the atom of hydrogen or of chlorine, instead of that of oxygen; and although it would be most unjust to forget the services of Dumas, Gerhardt, and Laurent, in this matter, the credit of removing the bars from H, Cl, and their comrades, and allowing the hitherto chained partners to walk at liberty, undoubtedly belongs mainly to our distinguished colleague and master, Professor Williamson.

The establishment of the water-type, or, to put it in another form, the proof that the atom of oxygen contains two units of oxygen, inseparably united but capable of separate action, led the way to the explanation of all the difficulties which beset the theory of radicals and copulæ. It at once explained how two oxides or two sulphides unite together,* and the idea of "polybasic," or as we should now say polyad, atoms and radicals was soon used to explain the existence of polybasic acids, double salts, acichlorides, and many other kinds of ternary compounds.

But a fact does not cease to exist because it is explained. Quick-lime and water unite together, although we can now explain how they do so, and a useful purpose may still be served by the enumeration, as in the old dualistic formulæ, of the pairs of united equivalents. Although some of these equivalents belong to the same atoms, it is nevertheless true that they are united in pairs. Caustic potash might, then, be formulated $KO\frac{1}{2},HO\frac{1}{2}$, or $\frac{1}{2}(K_2O,H_2O)$; phosgene gas, $\frac{1}{2}(CO_2,CCl_4)$; and chlorochromic acid, $\frac{1}{3}(2CrO_3,CrCl_6)$. These formulæ are not so well suited for general use as those now current, but the consideration of them as accurate representations of facts may enable us to see that the copulæ of Berzelius had a real and valuable meaning. Take, for instance, the formula of acetic acid—

$$H_3C—CO—OH,$$

or $\frac{3}{4}CH_4,\frac{3}{4}CO_2,\frac{1}{2}H_2O,\frac{1}{4}C_2$. It is this last term which indicates the coupled character of the compound. If we look upon acetic acid as a compound of carbon, it is a coupled compound, because all the equivalents of carbon in it do not belong to the same atom, and the two atoms of carbon are directly united together, and replacement of the equivalents united to one of these atoms does not very greatly affect the function or chemical character of the equivalents united to the other.

I have, perhaps, spent too much of your time upon these historical questions. Let us now shortly consider what is the present state of our knowledge as to chemical constitution. This I have already defined as the order in which the constituents are united in the compound. We may indeed use metaphorical language, and speak of the relative position of atoms, perhaps deluding ourselves into the notion that such language is more than metaphorical, but the phenomena of combination and decomposition, although we cannot doubt that they depend solely upon the relative position and dynamical relations of the atoms, are not alone sufficient to prove even that atoms exist. Our knowledge of the intimate structure of matter comes from another source, from the study of the properties, rather than of the changes of substances, and of the transformations of energy which accompany the transformations of matter. This is strictly a branch of chemistry: the aim of chemistry is to connect the properties of substances and the changes they undergo with their composition, taking this word in its widest sense; and we must not allow our friends in Section A to cut our science in two, and appropriate the half of it. We all frankly admit that chemistry is a branch of physics, but it is so as a whole— no section of it is more purely physical than all the rest. To accept a narrower definition of chemistry is to reduce ourselves to the position which the collector occupies among naturalists, it is to admit that it is our business to provide part of the materials out of which a science in which we have no share may be constructed by others. But we need not fear that this so-called physical side of Chemistry will ever be divorced from the study of chemical change. The names of Faraday and Graham among those who have left us, of Andrews among those who are still at

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* In 1838 Berzelius was inclined to regard C_2O_2, to which he gave the name "oxatyl," as the radical of oxalic acid and oxamide.

* It does not explain the existence of double chlorides, bromides, &c. These compounds, apparently so similar to the double oxides and sulphides, are still unexplained.

work, are sufficient proof of this, and a study of their researches will conclusively show that great results can be looked for in this direction only from a physicist who is also a chemist.

There are three special directions in which such investigations have already influenced chemical theory :—

1. *Electrolysis*, which has confirmed the equivalent as a chemical unit, has proved that equivalents unite in pairs —thus forming the basis of the electro-chemical theory, and has shown us how to estimate the amount of energy involved in the union of a given pair of equivalents.

2. *Vapour Density*, from which Avogadro inferred the law of molecular volumes (since proved by Clerk Maxwell), which has given us the molecule as a chemical unit, and formed the basis of the unitary theory.

3. *Specific Heat*, from which Dulong and Petit inferred their empirical law, which gives us the most satisfactory physical definition of the atom as a chemical unit.

We naturally turn to the future, and try to guess whence the next great revolution will come. For although periods of quiet have their use, as affording time for filling up the blank schedules furnished by the last speculative change, such periods have seldom been long, and each has been shorter than its predecessor.

But it is impossible to make a certain forecast. Looking back, we see a logical sequence in the history of chemical speculation, and no doubt the next step will appear, after it has been taken, to follow as naturally from the present position. One thing we can distinctly see—we are struggling towards a theory of Chemistry. Such a theory we do not possess. What we are sometimes pleased to dignify with that name is a collection of generalisations of various degrees of imperfection. We cannot attain to a real theory of chemistry until we are able to connect the science by some hypothesis with the general theory of dynamics. No attempt of this kind has hitherto been made, and it is difficult to see how any such attempt can be made until we know something in reference to the absolute size, mass, and shape of molecules and of atoms, the position of the atoms in the molecule, and the nature of the forces acting upon them. Whence can we look for such knowledge?

The phenomena of gaseous diffusion, of gaseous friction, and of the propagation of heat through gases have already given us an approximation to the size and mass of the molecules of gases. It is not unreasonable to suppose that a comparative study of the specific heat of gases and vapours may lead to some approximate knowledge as to the shapes of their molecules, and a comparison of such approximate results, with the chemical constitution of the substances, may lead to a hypothesis which will lay the foundation of a real theory of chemistry.

Chemistry will then become a branch of applied mathematics, but it will not cease to be an experimental science. Mathematics may enable us retrospectively to justify results obtained by experiment, may point out useful lines of research, and even sometimes predict entirely novel discoveries, but will not revolutionise our laboratories; mathematical will not replace chemical analysis.

We do not know when the change will take place, or whether it will be gradual or sudden, but no one who believes in the progress of human knowledge, and in the consistency of Nature, can doubt that ultimately the theory of chemistry, and of all other physical sciences, will be absorbed into the one theory of dynamics.

PROCEEDINGS OF SOCIETIES.

DUTCH SOCIETY OF SCIENCE AT HARLEM.

THIS Society held its 122nd general meeting on the 16th of May, under the presidency of G. F. van Tets. Since its last general meeting the Society has issued Nos. 3, 4, and 5, vol., viii, and Nos. 1 and 2, vol. ix., of the *Archives*

Neerlandaises des Sciences Exactes et Naturelles, and parts 1 and 2 of the second volume of *Natuurkundige Verhandelingen*. The " Huyghens " medal for this year was awarded to Dr. Kekulé for his researches on the constitution of the carbon compounds.

Prizes are offered for the following questions; all papers to be sent in by Jan 1st, 1876 :—

(1.) Exact researches on the solvent power of water, and of water charged with carbonic acid, upon gypsum, lime-stone, and dolomite, at different pressures and temperatures, and in case of the simultaneous presence of common salt, and of other salts extensively distributed in nature.

(2.) Similar researches on the solvent power of water, and water charged with carbonic acid upon silica, and the common natural silicates under the same circumstances.

(3.) New researches on the structure of the kidneys of mammiferous animals.

(4.) It appears to result from recent researches that the peptones of the different albumenoid matters are mixtures of substances partly known and partly unknown. Required a critical examination of these researches supplemented by personal investigations on the same question.

(5.) Exact determination, in Weber's unities, of the resistance of a column of mercury of a metre in height and of a square millimetre in section.

(6.) Improved experimental determination of the relations between the two kinds of experimental unities, the electro-magnetic and the electro-static.

(7.) New experiments on the influence of pressure upon chemical action.

To the following questions answers are required by Jan. 1st, 1875.

(1.) For ten kinds of glass, of known chemical position, required—the coefficients of expansion between 0° and 100°; the coefficients of elasticity; the indices of refraction for at least ten points in the whole extent of the spectrum.

(2.) Does the coefficient of expansion of steel vary with the degree of its temper, and is it possible to establish empirical laws on the connection between these two elements?

(3.) Does experiment enable us to establish a connection between the diffusion of liquids through porous septa, and other phenomena, such as those of capillarity?

(4.) Determine the coefficient of expansion of at least three liquids of simple composition.

(5.) Researches on the origin of the organs of sensation in the lower animals.

(6.) What are, in terrestrial magnetism, the periods known with approximate accuracy, and is it possible to connect these periods with other phenomena, cosmic or terrestrial.

(7.) New experiments and observations on the formation and mutual displacement of albumenoid matters in plants, preceded by a historical conspectus and criticism of former researches on the same subject.

(8.) The density, coefficient of expansion, melting-point, boiling-point, specific heat, index of refraction, and specific rotatory power of at least 20 organic compounds of known chemical constitution, each pair of which must be isomeric.

(9.) An extension of the researches of Regnault on the specific heat of the terpenes, and those of Berthollet on diamylene and triamylene to the largest possible number of other compounds in order to determine whether the specific heat of the polymers of a compound is, as a general rule, equal to that of the fundamental body which gives rise to them.

(10.) Investigation into the constitution of tetraphenol and its derivatives.

(11.) Critical examination of observations and experiments on the presence of bacteria in the contagious maladies of man and other mammalians.

(12.) Examination of researches on the growth of bones.

(13.) Study of certain Linnæan species of plants with a view to determine the definition of a species.

THE PUBLIC ANALYSTS AND THE REPORT OF THE ADULTERATION OF FOOD COMMITTEE.

IN commenting on this subject we remarked that the Public Analysts " to a man " rejected the proposals for a reference to Somerset House, and for a preliminary examination at South Kensington. This statement, we learn, has been challenged on the ground that one gentleman signified himself willing to accept the appeal to the Inland Revenue chemists. We still, however, adhere to our declaration, as the gentleman in question is not a Public Analyst under the Act, and was, consequently, no more entitled than ourselves to fill up the preliminary circular. We have also been asked why the Parliamentary Committee, in seeking for a board of referees and examiners, overlooked the claims of another establishment which enjoys Royal patronage—to wit, the Polytechnic College. We presume it was simply *fortune de la guerre* which gave the preference to Somerset House and South Kensington.

We have heard the complaint that to accept a board of referees elected by the Public Analysts would be allowing them to elect their own judges. We do not see the force of the objection. Every analyst who believes his own results correct will naturally wish that, if revised at all, they should be submitted to the ablest and most experienced men in the country. Even if the analysts may be considered as to some extent interested parties, that does not, according to the general custom of the country, disqualify them from selecting their own referees. Look, for instance, at the composition of the Parliamentary Committee. To a large extent it comprised gentlemen connected with the very trades whose doings were called in question. Were not the tea trade, the vinegar and mustard manufacture, the " corn-flour " business represented ? Was not the chairman himself, Mr. Sewell Read, a farmer, and thus, indirectly at least, interested in the milk trade ? Ill would it become such a Committee, or the Administration which appointed them, to object to the claim of the Public Analysts to select as referees a body of chemists in whom they have full confidence, and to whose award, in case of dispute, they would be prepared to submit.

Turning to questions of detail, we cannot help admitting that the taking of samples is involved in some difficulty. That an inspector, on tendering payment, should have an absolute right to obtain samples of any substance offered for sale is self-evident. But what about the transmission of samples, and about the right of the shopkeeper to have an identified sample to send for analysis to any chemist he or his legal adviser may select ? It was proposed that the inspector should have the power, if required, of sealing up a second sample at the same time, and leaving it with the suspected tradesman. To this it was objected that the inspector might be bribed to lend the shopkeeper his seal, and that the latter might make up a pure sample, and forward it for examination; thus not only escaping from all penalties, but ruining the professional standing of the Public Analyst. But, without at all sanctioning the imputation that the inspectors are open to bribery, let us ask whether a seal is really any guarantee for the identity of the sample. Let us suppose that Inspector A calls upon B, grocer and tea dealer, and obtains a pound of ground coffee, sold as pure, but suspected of being chicoried. He makes up this sample, in presence of B, into two parcels, which he secures with his official seal. One of these he takes with him and formally delivers to C, the Borough Analyst. The other he leaves with the grocer. What is to hinder the latter from taking an impression of the seal with the crumb of bread, and then melting it, open, removing the contents, and replacing them with pure coffee ? He then re-closes the parcel, softens the wax, applies his forged seal, and dispatches the whole to any chemist he thinks proper. When the case comes to trial the Inspector will be obliged to admit that the sample analysed on behalf of the defence bears his seal and any private marks which he has made for better identification. We suggest that the check-sample should be left in the custody of some public official who is above suspicion, and should be sent to any chemist whom the defendant may select, through the medium of the post-office, without ever being placed in the hands of any person interested either in the prosecution or the defence.

The important suggestion was made that, as concerns articles sold avowedly as mixtures, such as coffee with chicory, mustard with flour, &c., it should be obligatory upon the seller to declare not merely the bare fact of the admixture, but its amount. This proposal meets with our warmest approval. An article may be sold, under the law as at present existing, as a mixture of coffee and chicory, but whether the chicory forms 10, or 40, or 70 per cent, the purchaser has no means of ascertaining. Nor could the seller be legally convicted if even 1 per cent of coffee were present. The " declaration of admixture " requires also some amendment. It should be printed on the package in a prominent manner, and on a place which will be visible when it is closed up. One of the Public Analysts present at the recent meeting mentioned a case where the notice was placed on the inside of the package.

We shall await with interest the conclusions of the Committee appointed by the Public Analysts to consider the above and a variety of other important points.

CORRESPONDENCE.

SUSPENSION OF CLAY IN WATER.

To the Editor of the Chemical News.

SIR,—I have read with much interest the paper by Mr. Durham on the above subject in the CHEMICAL NEWS, vol. xxx., p. 57, and shall feel obliged if you permit me to draw attention to the following extract from a memoir by Dr. Sterry Hunt, which he read, on February 18, before the Society of Natural History, Boston, U.S.

" Having examined the water of the Mississippi near its mouth, he found it to contain about 1-2000th of suspended matter, chiefly clay, which required from ten to fourteen days to subside. He, however, observed that the addition of sea-water or of salt, sulphate of magnesia, alum, or sulphuric acid, rendered the turbid water clear in from twelve to eighteen hours. He thus explained the ready precipitation of the suspended clay when the river water comes in contact with the salt waters of the Gulf of Mexico, causing thus great deposits of fine mud, and helping us to understand the origin of the accumulations of argilites and clay slates which are met with in various geological formations. An explanation of this phenomenon is to be found, Dr. Hunt thinks, in the researches of Guthrie on the formation of drops (*Proc. Roy. Soc.*, xiv., 1864). Studying the size of drops of water falling from a small sphere of ivory, he found that the cohesion of the water was diminished when it held saline matter in solution, as was shown by the smaller size of the drops. This was verified by experiments with solutions of various strengths of nitre and chloride of calcium. It was found that the addition of 8 parts of the latter salt to 1000 parts of water reduced by one-ninth the size of the drops, which was determined by their diminished weight. These results show a diminished cohesion of the liquid to the ivory sphere, from which it was by the force of gravity made to fall. The cohesion, in virtue of which extremely attenuated particles of clay are held in suspension in water in opposition to gravity, is in this manner so far reduced by the addition of saline matters that gravity and cohesion rapidly assert themselves among the suspended particles, which collect together and subside, leaving the saline liquid clear. The precipitation of suspended clay is made very rapid when a strong solution of salt is employed."

It will be noticed that Dr. Hunt's observations are almost the same as those given by Mr. Durham.

Their interpretation of the phenomena, however, is different; but as Mr. Durham hopes shortly to put his idea to the test of experiment, those interested in the matter will await his further inquiries.—I am, &c.,

T. R. O.

Greenock, August 10, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, No. 26, June 29, 1874.

New Property of Metallic Rhodium.—MM. H. Sainte-Claire Deville and H. Debray.—The authors found long ago, on employing zinc as solvent of the platinum metals, that the pulverulent and metallic matters obtained after the separation of zinc by acids had singular properties, which they have carefully studied. When rhodium and iridium are thrown down from their solutions by formic acid or by alcohol, the finely-divided metallic powders have properties which are briefly mentioned to claim priority. Rhodium, in the state in question, decomposes formic acid with evolution of heat, reducing it to hydrogen and carbonic acid. At a slightly higher temperature pulverulent rhodium transforms alcohol in contact with alkalies, hydrogen being given off, and an alkaline acetate formed, even in very dilute liquids. When the action of rhodium upon formic acid becomes enfeebled, it is merely necessary to wash the metal, and dry it in contact with the air, to restore it to its full efficacy. Platinum and palladium, prepared in a similar manner, have no effect upon formic acid, whilst iridium and ruthenium act like rhodium.

Theory of the Shock of Bodies, taking the Atomic Vibrations into account.—M. A. Ledieu.—Conclusion of the paper begun in the *Comptes Rendus* for June 22. The author considers the use of the general relations obtained in the preceding part of this paper for the solution of questions on the shock of bodies occurring in industrial mechanics; general expression of the loss or gain of *vis viva* for the whole of a body struck between any two instants of the collision, and the true expression of Carnot's theorem; different cases of equality between the total *vis viva*, whether real or of the entire mass, before and after the shock; and, lastly, observations on the determination of the mechanical equivalent of heat by crushing lead.

Spectra of Vapours at Elevated Temperatures.—J. N. Lockyer.—Mr. Lockyer's communications relate to the molecular structure of vapours, considered with regard to their densities, and the manifestation of the modifications produced in the structure of the molecules. The general results are that if we consider like spectra as indicative of like molecular condition it must be said that the vapours whose densities have been determined cannot have been in the same molecular conditions.

Report on the State of the Preparations for the Expeditions Arranged by the Academy to Observe the Transit of Venus, December 9, 1874.

Report on the Measures to be taken against the Phylloxera.—The steps recommended are—Owners of vineyards compelled to declare the appearance of the phylloxera; appointment of experts by the prefects to examine the existence of the evil, and estimate the amount of damage. Destruction of the infested vines when thought necessary to hinder the spread of the disease. Compensation to the proprietors in such cases. Chemical disinfection of the soil, and destruction of all roots, stems, leaves, &c., of the vines by fire. The same ground not to

be re-planted with vines until some other crop has been grown upon it.

Temperature of the Sun.—M. J. Violle.—The author describes his apparatus and methods, and concludes that the temperature of the sun at Grenoble, on June 20, at 3.30 p.m., was 1354°.

Concerning the above researches of M. Violle, H. Sainte-Claire Deville remarks that it is not prudent to speak of temperatures above those which have been measured, the highest of which probably has been determined by the experiments of Bunsen. In speaking of calorific phenomena produced by combination we must remember that, in given conditions of temperature and pressure, the quantities of matter which combine, and consequently the amounts of heat produced, are limited by the phenomenon of constant dissociation—a limit which the speaker's experiments place very near to measurable temperatures. It is, therefore, not permissible, until the contrary has been demonstrated, to speak of those fabulous temperatures which have often been mentioned.

On High Temperatures.—M. Berthelot.—The author remarks that the existence of high temperatures as a general principle, and the possibility of realising them, must be carefully distinguished. Our present theories indicate that a given gaseous mass may acquire a *vis viva* indefinitely increasing—that is to say, an unlimited temperature, at least as far as simple gases are concerned, and as long as we do not throw any doubt upon the absolute character of the laws of Mariotte and Gay-Lussac. With this reservation there would be no other limit conceivable than that which would correspond to the destruction of our present elements, and their resolution either into simpler elements, or into an universal ethereal matter. But, in fact, it may be that the intensity of the radiations of every kind, augmenting with extreme rapidity as the temperature rises, and consequently the loss of *vis viva* which communicates itself to the surrounding media, becomes more and more considerable. Thus the realisation of every temperature exceeding the limit bordering on 2500° or 3000°, observed in the experiments of Sainte-Claire Deville, is rendered impracticable.

Application of Bisulphide of Carbon, mixed with Tar and Alkalies, for the Destruction of the Phylloxera.—In this combination the use of this agent produces no danger, either to the operator or to the vine.

Telluric Theory of the Dissemination of Cholera.—Dr. Decaisne.—The author explains the local distribution of cholera on geological principles, and ascribes the immunity of Lyon to the fact of its resting on granite.

New Method of Determining the Index of Refraction of Liquids.—MM. Terquem and Irannin.—The apparatus which the authors propose would scarcely be intelligible without the aid of a diagram. The results which the authors obtain by their method agree closely with those found by Fraünhofer, Dale, and Gladstone.

Electro-Static Phenomena in Batteries.—Alfred Angot.—The author concludes that an isolated battery has the same electric capacity as a conductor of the same dimensions.

Evaporation of Liquids at Temperatures Higher than the Boiling-Point.—M. D. Gernez.—The law of Dalton does not apply rigorously to the evaporation of superheated liquids, but it may be regarded as giving results approximating to those furnished by experience.

Phosphorescence of Phosphorus, Sulphur, and Arsenic.—M. Joubert.—The phosphorescence of phosphorus takes place neither in a perfect Torricellian vacuum, nor in a gaseous atmosphere free from oxygen. If the latter gas is perfectly excluded, phosphorus may be melted and distilled without the least phosphorescence. The total pressure of the mixture, which puts an end to the luminous appearance, is so much the greater as the proportion of oxygen is lower. Sulphur and arsenic possess exactly the same properties. Sulphur becomes luminous

at about 200°, and arsenic at a somewhat higher temperature. In each case the presence of oxygen is essential, and the pressure of this gas must be within determined limits.

New Apparatus, called Accelerometers, for Observing the Phenomena of the Combustion of Powder.—MM. Deprez and H. Sebert.—The results of the experiments are given in tables not suitable for insertion.

Intestinal Calculus of the Sturgeon.—MM. Delachanal and Mermet.—The calculus contained lithia in notable amount, capable of quantitative determination, a circumstance of interest, as bearing upon the composition of the waters of the Caspian and of its affluents.

Results Obtained with the Use of Phenic Acid in Inhumations.—M. Prat.—Four bodies were placed in sawdust saturated with phenic acid, exposed to the air in this state for two months, and were then buried. They were afterwards exhumed, the one after the lapse of two years, and the three others after five years. The author found on examination that the phenic acid had greatly modified the course of putrefaction. Decomposition remained stationary as long as the phenic acid was able to act, but when it disappeared, by evaporation or other causes, the putrefaction resumed its course with much greater rapidity, and the bodies were converted into adipocire.

Presence of Lead in the Brain.—M. Daremberg.—With reference to the case stated by MM. Bergeron and l'Hote (*Comptes Rendus*, June 15, 1874), it may be mentioned that in cases of chronic lead-poisoning that metal has been detected in the brain.

Moniteur Scientifique, du Dr. Quesneville,
July, 1874.

New Fulminate with a Base of Picrate of Lead.—M. Prat.—Picrate of lead has the property of detonating when struck, and—according to the author—may serve as a substitute for fulminate of mercury in percussion caps. He also gives an account of an explosion which occurred in his laboratory on triturating together chlorate of potash, picrate of lead, and amorphous phosphorus.

Fixation of Mordants of Iron and Alumina.—E. Schultz.

Dyeing with Artificial Alizarin along with Mordants of Iron and Alumina.—A. Schultz.—These two long and valuable papers do not admit of abstraction.

Report on the Alteration, the Corruption, and the Purification of Rivers.—A. Gérardin.—The author maintains that the only means of ascertaining the purity of water is to observe whether animal and vegetable life can be supported in it. If all organic beings, except infusoria and cryptogamous plants are destroyed, the water is infected. The fish which inhabit a river guarantee it.

MISCELLANEOUS.

Programm der Königlichen Rheinisch-Westfälischen Polytechnischen Schule zu Aachen.—A prospectus of one of the admirably constituted schools of practical science to which Germany owes no small part of its rapid industrial progress. In those departments in which we are more especially interested, we find that this establishment has a professorship of pure chemistry, held at present by Dr. Landolt, with two assistants; a professorship of technical chemistry, with two assistants; a professorship of mineralogy; and one of physics. There is a laboratory for pure chemistry, with a museum of specimens; a laboratory for applied chemistry, with a technological and metallurgical museum, a mineralogical and palæontological museum, and a sanitary and anthropological museum. The students have especial practice in arranging and planning chemical manufactories of various kinds, and thus, if they obtain in after life an appointment at any chemical works, they possess at the very outset a full acquaintance with the whole plant, buildings, and machinery. This department is, to the best of our knowledge, sadly neglected in the education of practical chemists in England. Will the new Yorkshire College of Science follow this example? There is another point which deserves particular notice. All the professorships at Aachen, and we believe at all similar establishments in Germany, are evidently held by natural-born subjects of the German Empire. The German educational authorities are aware of the necessity of training up talent and research at home, instead of importing it from abroad; they know that nothing is more discouraging to students than to see honourable positions given to foreigners rather than to natives. There are at Aachen separate faculties or courses of study for architects, engineers, geodesists, mechanicians, chemists, and metallurgists. This separation of the different departments is a characteristic, and, in our opinion, a most valuable, feature of all establishments for higher education in Germany. The Germans attach very little value to the views of a man on any question except he is "ein Mann vom fach,"—a specialist who has devoted himself to that particular subject. In this country we unfortunately believe that a man of general education is qualified to give an authoritative deliverance on any subject; hence we allow our students to spend the bulk of their time at college in studies having no special bearing on their ultimate destination, fondly hoping that they can "pick up" afterwards those sciences on which their reputation, their success in life, and their usefulness to the public are to depend. The annual fees for students at the Aachen Polytechnic do not at the utmost exceed six guineas! Let this be compared with the scale of charges at our School of Mines. How often must we be warned of the necessity of altering our educational plans if we would maintain our industrial position?

NOTES AND QUERIES.

Manufacture of Bichromate.—Can any of your readers inform me of a ready method of ascertaining the amount of decomposition of chrome ore in a charge while being furnaced in the manufacture of bichromate?—RIA.

Solution of Sulphur in Carbonate of Potassium.—I have recently had occasion to notice the following remarkable reaction, of which I can find no mention in the various authorities which I have consulted:—I added sulphur (in the form of "flowers") to a boiling solution of K_2CO_3, in which it was rapidly and completely dissolved, with evolution of H_2S and CO_2, to a clear solution of a rich orange colour, which on cooling changed gradually to pale yellow. A portion of this solution I reserved for examination: the remainder I evaporated to dryness over the water-bath, an operation attended throughout with the disengagement of H_2S. The resulting residue was of a yellow colour, and extremely deliquescent; re-dissolved in distilled water, it was found to be characterised by the following reactions, which are identical with those obtained with the original solution:—1. HCl caused an immediate separation of S, attended with slight effervescence due to excess of K_2CO_3. 2. $FeSO_4$ (solution) gave a black precipitate of FeS. 3. $AgNO_3$, a mixed precipitate—part of which was orange-brown, and part black, the whole soon assuming a uniformly black appearance. From these and other reactions I infer (1) the presence of potassic sulphide and hyposulphite, and of H_2S both free and combined, and (2) that the H_2O of solution, being the only possible source of H, has been decomposed to furnish H_2S; and, therefore, that the whole reaction may be fairly summed up in the following equations:—

$$
\begin{array}{l}
\qquad\qquad\qquad\;\; \text{Potassic} \quad\;\; \text{Potassic} \\
\qquad\qquad\qquad\;\; \text{pentasulph.} \;\; \text{hyposulph.} \\
\text{(1). } 3(K_2CO_3) + S_{12} = 2K_2S_5 + K_2S_2O_3 + 3CO_2 \\
\text{(2). } K_2S_5 + 3H_2O = K_2S_2O_3 + 3H_2S
\end{array}
$$
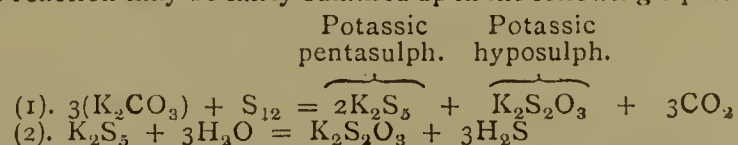
These are but tentative, and I am still doubtful on two points—(1) As to whether KHS is formed or not; and (2) as to how so much H_2S comes to be evolved in presence of K_2CO_3. I shall be glad to learn if this is a new reaction; if not, by whom and where it has been before published.—CHAS. CROSS.

TO CORRESPONDENTS.

THE CHEMICAL NEWS.

VOL. XXX. No. 770.

THE COMPOSITION OF THE FIBRE OF THE JUTE PLANT, AND ITS USE AS A TEXTILE MATERIAL.*

By Professor HODGES, M.D., F.C.S.

At the Meeting of the Association held in this College twenty-two years ago, I had the honour of reading before this Section a report on the composition of the flax plant, the fibre of which supplies the raw material of the staple industry of this part of Ireland. In that and subsequent reports I gave an account of a series of investigations which had been undertaken by me at the request of the Association, and in which the composition of the fibre, and the changes which it undergoes in its technical preparation, were for the first time completely examined. The interest which these reports excited in this great centre of the linen industry has encouraged me to submit to the Section some account of the history and chemical composition of another textile material, which at the time of our former Meeting was scarcely known in this country, but which has lately assumed a most important place among the vegetable substances employed by manufacturers. Fifty years ago the fibre of the jute plant was to be found only in our museums; now the quantity of it introduced into the United Kingdom almost equals that of the flax which we import, and exceeds the annual importation of hemp, and, owing to the improvements which have been effected in the processes for its preparation, and especially in the methods of bleaching, it is, I believe, destined to occupy in future a more important place among the raw material of our textile manufactures. The plant which yields the fibre known in commerce as "jute," a name which is supposed to be derived from a corruption of the Bengali name of the plant, is a member of the family *Tiliaceæ*, the linden or lime-tree family, which from remote periods has been cultivated by the natives of Southern Asia for textile purposes. Two species of it are used for the production of fibre, *Corchorus Capsularis* and *Corchorus olitorius*, and both kinds are found in the jute brought to this country. The *Corchorus* is an annual, the seeds of which are sown broadcast in the months of March and April, on ploughed land along the sandy banks of rivers, usually neither irrigation nor manure being required. In August, before the seeds, which replace the small yellow flowers of the plant, have ripened, and when the stems have attained the height of about 12 feet, the crop is cut; when the seed is allowed to become fully ripe, as is also the case with flax, the fibre becomes stiff and hard, and the stem is rendered of a reddish colour. The stalks, when cut, are tied in bundles and placed in tanks, usually of dirty water, and allowed to ferment, or "ret," for five or six days, and then taken out and swung about repeatedly in the air, by which the long fibres are separated from the brittle wood which constituted the bark of the stem, and, thus prepared, the fibres are dried by exposure on the ground to the air, and, when dry, packed in round bundles for the market. The treatment of the plant for the separation of the fibre is therefore precisely like the ordinary methods used by farmers in this country in the preparation of the flax fibre. The produce of jute far exceeds that of flax, being, it is stated, five times as great as that which flax affords. Though India is the great seat of jute cultivation, and supplies the fibre used in this country, yet the jute plants, especially *Corchorus olitorius*, have been long cultivated in China

and other Eastern countries. Experiments have been made to grow the plants for textile purposes in the Southern States of America, on the banks of the Lower Mississippi, and also in Algiers, and it is said the results are encouraging.

A large portion of the jute grown in India is used in making sacks, which, under the name of *gunny* bags, are sent in great numbers to America to be used for packing cotton. Dr. Royle states that textures from other Indian plants, as well as from the jute, are used for the manufacture of these bags, among others the fibres of the *Crotolaria juncea*, the Bengali name of which, *goni*, is supposed to be the origin of the term "gunny" applied to the bags. In the monthly reports of the Department of Agriculture of the United States of America, it is stated there were lately in the States two-hundred looms working jute, and that their existence depended entirely upon the imported gunny cloth.

For some time after the introduction of jute, the opinion prevailed that it could not be bleached, and was therefore of little value as a textile material. Experiments made at several times proved that this was a mistake, but until lately scarcely any progress had been made in improving the qualities of the fibre, or giving it the whiteness of linen fabrics. The difficulties, however, which retarded the success of jute bleaching have during the present year been completely removed, by the application of methods which have been patented by my son, and which are at present in operation at works erected for the purpose by Mr. W. Sibbald Johnston, of this town, at Mile-Cross, near Newtownards, in the neighbouring county of Down. In the processes employed, the cloth or yarn, by means of ingeniously arranged machinery is made to pass in succession through baths of alkaline solutions and hypochlorites of magnesia and soda, the magnesia used being economically obtained from kieserite, which is found in large quantities in Germany in the kainite deposits, and has hitherto been regarded as of but little commercial value.

The length of the fibre of the jute of commerce is frequently no less than 12 feet; usually the lower end near the ground is dark-coloured and woody. At first the fibre is colourless or only slightly coloured, but some kinds after a time become darker, just as wood darkens in colour by the action of the air. Many specimens preserve a dull yellowish colour, and in appearance can with difficulty be distinguished from the finer qualities of hemp. The microscope, however, shows us that the structure of the jute is different from that of any of our common textile fibres; thus, while a fibre stripped from the flax plant is shown to consist of bundles of cells with thick walls and somewhat circular outline, and exhibiting a very minute central space, the wall of the jute cell is of very irregular thickness, and the central space does not conform to the external outline, but at one part will be found wide, while at another part it dwindles to a mere line. By this remarkable difference in the contour of the inner and outer cell walls, jute fibre is distinguished from flax, hemp, cotton, and New Zealand flax. The application of the sulphate of aniline proposed as a reagent for woody matter by Runge, and recommended by Professor Wiesner, of Vienna, also affords us assistance in distinguishing it from both hemp and flax fibres. Thus, while hemp is scarcely at all affected by this action of the reagent, and flax unchanged in colour, the jute fibre shows that it contains a large amount of woody matter by becoming of a deep golden-yellow colour. The sulphate, however, does not enable us to distinguish jute from several other Indian fibres.

In connection with the technical preparation, bleaching, &c., of the jute fibre, I lately commenced a series of investigations which, though not so far advanced as I had hoped, may not be destitute of interest. The samples of fibres which I submitted to examination were kindly supplied to me by Mr. Sibbald Johnston, proprietor of the Kiltonga Bleach-Works, and were of the kind known as "Red Seraigunge." The fibre had a faint red colour, and

measured in length 10 feet 9 inches. It had been prepared in the ordinary manner, and of course contained only those constituents of the plant which remained attached to the cellular structures after being submitted to the process of retting. Portions of the fibre cut into small pieces, after being treated with distilled water, and boiled for several hours, gave an acid solution, of the colour of pale ale, which evolved an odour which suggested the aromatic smell of moist flax yarn. On evaporation over the water-bath, it left a brownish black extract, which in appearance resembled black-currant jelly; it was translucent at the edges, and was easily reduced to a light brown powder. This extract amounted to only 0·726 per cent of the fibre, and was found to contain sugar and a tannic acid which gave an olive-green precipitate with per-salts of iron, a fatty substance, and a brown-red colouring matter. The extract was in part soluble in alcohol, and heated on platinum it carbonised without melting, leaving a white ash. It contained no starch. The fibre employed, dried at 212°, was found to contain 15·5 per cent of moisture, and, when incinerated, to leave 1·329 per cent of ash, of a pale yellowish white colour; treated by the successive action of solvents, according to the methods described in my reports on flax, and the amount of nitrogen determined by Wills's method, both in the original samples and in the fibre after the action of the solvents, the results obtained were as follows :—

100 parts yield—

Moisture	15·540
Organic matter	83·131
Mineral matters.. ..	1·329
	100·000

(See reports of the British Association for 1852 and 1853).

100 parts of the fibre, dried at 212°, yield—

Wax and fatty matters soluble in ether ..	0·235
Tannic acid and colouring matters soluble in alcohol..	1·135
Sugar, pectine, &c.	2·427
Soluble nitrogenised matters	0·512
Insoluble nitrogenised matters	2·433
Inorganic matters united with the fibre ..	1·010
Cellular fibre	92·248
	100·000
Nitrogen in the original fibre..	0·291
Nitrogen in the fibre after treatment with solvents	0·210

I had hoped to be able to give an analysis of the jute plant in the condition in which it is removed from the field, but unfortunately a specimen which had been forwarded from Calcutta arrived only a few days ago, and I must therefore defer its investigation until some other opportunity. With respect to the magnitude of the jute manufacture, I may state that in the present year 100,000 tons of the fibre were imported into Dundee alone by direct shipment from Calcutta, while London, Liverpool, and Glasgow received probably half as much more. The rapidity with which, by means of improved machinery, it can be manufactured may be judged from the fact that, since the opening of the Suez Canal, the fibre has been delivered in Dundee, spun and woven, and the goods shipped back, and paid for, viz., within six months from the date of the bill of lading. At the present time jute is used for the manufacture of a great variety of fabrics; in fact, it will serve for the production of every kind of coarse textile material. It is even used as a substitute for hair, and can be formed into admirable chignons. The dust from the mills is employed to make silk hats, and the waste fibre yields an excellent pulp for the manufacture. Stair-carpets of jute, with bright colours, can be sold at 3d. per yard, and, woven into what are known as carpet bed-covers, a fabric is produced at not more than one-third the price of wool.

ON THE
PETRIFIED WOOD OF LOUGH NEAGH.*
By Professor HODGES, M.D., F.C.S.

The occurrence along the shores of Lough Neagh, in this province, of masses of petrified wood has, from very early times, attracted attention, and many ancient writers, amongst others, Boetius, in his history of stones and gems, and several modern authorities, have ascribed to the waters of this lake remarkable petrifying qualities. In fact, popular opinion has so generally attributed these properties to them, that in a report some years ago made to the Water Commissioners by an English engineer of high reputation, on the water supply of this town, we find the water of the lake described as totally unfit for use, " as from its well-known property of coating wood and other matters immersed in it, it is unquestionably hard."

Bischof, in his " Chemical Geology," also refers to the property of the water of petrifying wood placed in it, or rather causing its impregnation with iron, which induced him, he says, to make a chemical analysis of it. He, however, merely examined the insoluble portion of the matters left on evaporating the water, and found, contrary to what he had expected, that there was an extraordinary small quantity of earthy constituents. From the suspended matter, by means of hydrochloric acid, he extracted iron and alumina, but in too small a quantity to admit of estimation. The fact that peroxide of iron, he remarks, is the chief constituent of the suspended matter, is in accordance with the statement in the *Philosophical Transactions*, that the lapidifying substance is iron, and that when the petrification is only partial upon burning such a wood, only the petrified part comes to a glow heat, and the ash which is left is attracted by the magnet. Bischof also made a partial examination of a specimen of the petrified wood, which, however, does not sustain his views respecting the ferruginous nature of the lapidifying material, as he found it to contain only 0·54 per cent of oxide of iron and alumina; so he expresses the opinion that the petrified wood had certainly not been lapidified by the water of the lake, but resembled the silicified wood occurring in the brown coal formations.

The specimen of petrefied wood examined by Bischof gave the following results :—

Silica	97·71
Oxide of iron and alumina..	0·53
Loss on ignition	0·54
Loss and organic matter ..	1·22
	100·00

On ignition, only a feeble empyreumatic odour was perceptible and a slight darkening in colour.

The popular notion respecting the properties of the water of this lake are even at the present time entertained by many persons of education, and the opinion which in early times prevailed, that when a piece of wood is fixed in the water along the shores of the lake, in the course of seven years the part immersed in the water is changed into stone, while the part in contact with the muddy bottom is transformed into iron, the portion of the wood exposed to air remaining unchanged, has not entirely passed away.

Immense masses of the petrified wood have been found along the shores of the lake, and the Rev. Dr. M'Closkie, in an excellent paper read some time ago before our local Natural History and Philosophical Society, has given an account of the numerous localities, not merely on the drift deposits along the lake, but a considerable distance inland, in which specimens have been discovered. Some of the pieces of wood discovered are of large size, and one mass described by Dr. Barton, in his " Lectures on Natural Philosophy," &c., published in Dublin in 1751, weighed so much as 700 lbs.; and there is at present, or was lately,

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* Read before the British Association, Belfast Meeting, Section B.

at Langford Lodge, near Crumlin, in this county, a silici-fied trunk, 10 feet long, and about the same in circum-ference. The specimens discovered vary very much in hardness and in colour; when associated with lignites they are easily split and dark coloured, but when occurring as boulders in the drift they are bleached on the surface white; the interior is black or dark brown. On the surface of some of the specimens minute crystals of quartz are found. The woody structure of the petrifactions is in general well marked, and microscopic examination shows it to be that of coniferous trees. By Kraus, it has been named *Cupress oxylon Pritchardi,* which, among living Coniferæ, is represented by Cupressaceæ and Podo-carpeæ.

Having on several occasions submitted the water of Lough Neagh to chemical examination, and also made analyses of specimens of the silicified wood, a report of my results may be interesting to the section. These analyses show that in no part of the lake does the water contain any considerable amount of solid matter, and that neither in the water nor in the petrified wood is to be found more than a very minute quantity of iron. A specimen of the water which was kindly forwarded me last month by Mr. Turtle, of Aghalee, and which had been taken at Sandy Bay, 100 yards from the shore, and 4 miles from Glenavy river, near a part of the lake shore in which the petrified wood is frequently discovered, when received by me was slightly turbid from finely-divided flocculent matter, and colour, when viewed through a layer 2 feet in length, was pale greyish yellow. Its taste was soft, and a considerable number of animalculæ were moving about in it. It had an alkaline reaction.

On evaporation, it left a yellowish coloured residue which became black on ignition.

An imperial gallon contained 12·950 grains, consisting of—

Mineral and saline matters   10·826 grains.
Organic and volatile ..   ..   2·124   ,,

The mineral matters were found to consist of—

Carbonate of lime	4·786
Carbonate of magnesia ..	0·496
Carbonate of soda	1·038
Sulphate of soda	1·711
Oxide of iron	0·727
Silicic acid	0·360
Chloride of sodium	1·704
	10·826

I also determined the amount of mineral matter con-tained in the water at two other portions of the lake. A specimen taken at the mouth of the river Bann, which, rising from springs in the granitic range of the mountains of Mourne, after a course of about thirty miles falls into Lough Neagh, and after passing through it issues as the Lower Bann at the north end of the lake, and serves, on its course to the sea, to divide the County of Antrim from the County of Londonderry, was found to yield 13·4 grains of solids, of which 10·6 grains consisted of mineral matters, while in another locality, about half a mile from the shore, the mineral matters were only 9·3 grains per gallon.

The water of the Upper Bann, except when it has been rendered impure by the numerous bleaching and other works on its banks, contains a very small amount of mineral matters. A gallon on one occasion I found to contain only 4·654 grains of mineral matters, consisting of—

Carbonate of lime	1·239
Sulphate of lime	1·353
Carbonate of magnesia ..	0·622
Oxide of iron	0·329
Silicic acid	0·205
Chloride of sodium	0·825
	4·654

A specimen of the petrified wood weighing 26 ounces, which the woody structure was clearly visible, and

which was white on the outer surface and of a dark brown colour in the interior, when exposed to a strong heat in the crucible became black, and evolved an odour some-what resembling that of burning wood, and, by continuing the heat, left a pale buff-coloured residue. Contrary to what is stated by some authorities, the wood was not affected by the magnet before or after ignition. In no specimen which I have examined have I found the ash magnetic.

100 parts of the specimen I found to yield as follows:—

Loss on ignition and organic matter	6·50
Alumina soluble in hydrochloric acid	0·68
Oxide of iron	0·04
Lime	0·29
Magnesia	0·25
Phosphoric acid	trace
Alumina in state of silicate	1·95
Lime	1·10
Magnesia	0·25
Silicic acid	89·01
	100·07

In another specimen from a different locality the loss on ignition was 9·1 per cent. It contained 84·5 per cent of silica, and only 1·5 per cent of oxide of iron and alumina.

The analyses therefore show that the water of Lough Neagh, in our time at least, possesses no peculiar quali-ties, and that the lapidifying material of the petrified wood is silicic acid, and not oxide of iron.

The examination of the specimens also clearly show that the hardening is not produced merely by superficial incrustation of the lapidifying silicic acid, but that it has penetrated through almost every portion of the vegetable structure.

ON NATIVE CUPREOUS SULPHARSENIATE.
By R. W. EMERSON MACIVOR.

A VERY good specimen of dufrenoysite from Switzerland having come into my possession, I resolved upon sub-mitting it to a careful examination, with a view of removing the doubt existing as to the constitution of this mineral. The following is a description of some of the more im-portant properties of the mineral, and its analysis:—It is crystallised in small mono-metric crystals of a dark grey, almost black, colour. Its specific gravity is 5·52. Before the blowpipe it exhales arsenical vapours, and fuses to a black mass. When exposed to the action of heat in an ignition-tube, it yields a sublimate composed of a mixture of arsenic trisulphide with uncombined sulphur. It is completely decomposed by nitro-hydrochloric acid. These numbers represent the results of the analysis of the speci-men, neglecting small percentages of the sulphides of lead and iron—

Copper	46·05
Silver	2·43
Arsenic	18·79
Sulphur	32·46
	99·73

If the 2·43 per cent of silver be replaced by an equivalent proportion of monovalent copper, these numbers are found to agree very well with the theoretical percentage com-position of normal cupreous sulpharseniate, $Cu_3(AsS_4)'''$.

	Found.	Calculated.
Copper	47·48	48·29
Arsenic	18·79	19·10
Sulphur	32·46	32·61
	98·73	100·00

The above results would seem to prove Stockar-Esher's view that cupreous sulpharseniate is dimorphous, as the mineral enargite has also the formula $Cu_3(AsS_4)'''$.

Glasgow, August, 1874.

NOTE ON THE ANALYSIS OF SUGAR.

By J. M. MILNE, Ph.D.

THE determination of the fruit sugar in samples of raw sugars is a matter of no difficulty in the hands of a careful manipulator, but there are a few points in detail which are deserving of attention. The usual plan, still in use in some laboratories, of taking a weighed quantity of the sample, dissolving in water, and making up to a given bulk, and using the liquid so obtained for the determination of the fruit sugar, is by no means always to be relied on. There is no doubt, I think, that many dark-coloured sugars contain other substances (probably albuminous) besides the fruit sugar capable of reducing copper solution, and which must first be separated before correct results can be obtained. The method recommended by Fresenius, of adding lead acetate to the sugar solution till no further precipitate is formed, may be advantageously employed for this purpose. While in some samples the same amount of fruit sugar is found in the solution *before* precipitation with lead as that obtained *after* the addition of that reagent, in others the difference is very marked. The following results, obtained from a sample recently submitted to me for analysis, will illustrate this:—The sugar solution *without* treatment gave 4·90 per cent of fruit sugar, while in a measured quantity of the same solution *after* precipitation by lead acetate the amount found was 3·27 per cent.

The following method of procedure answers very well, and is employed by me for *all* sugar samples in which fruit sugar is to be determined:—5 grms. of the sample are dissolved in a moderate quantity of water, and the insoluble matter allowed to subside. The supernatant liquid is then carefully poured into a 100-c.c. flask, the insoluble treated with more hot water and finally collected on a small weighed filter, and the washing continued till the flask is about three-quarters full. To the sugar solution a little solution of tribasic acetate of lead is added, the whole well shaken, and the precipitate allowed to subside. The clear liquid is then tested with a drop or two of acetate, and, if no further precipitate is produced, the contents of the flask are cooled to the proper temperature, and finally made up to the mark with water, the whole being thoroughly mixed. When the precipitate has subsided, the liquid is passed through a *dry* filter into a clean dry glass, and, when sufficient has passed through, is ready for the fruit-sugar determination. If it is desired to determine the extractive matters *directly*, the precipitate in the flask is washed several times by decantation, and then placed on the filter (previously weighed), and the washing continued till a drop of the filtrate no longer gives a precipitate with H_2S; the filter and contents are then dried as usual. By the above method of treatment, a clear colourless solution is always obtained, which renders the further operations with the copper liquor much easier.

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Qualitative Detection of Arsenic in Organic and Inorganic Matter.—MM. Mayencon and Bergeret.—The authors place pure zinc in a small flask containing distilled water acidulated with pure sulphuric acid, and close its neck imperfectly with cotton-wool, to prevent drops of the liquid being thrown upon the test-paper, which is simply tissue paper moistened with a solution of bichloride of mercury, and used before it dries. If this paper is exposed to pure hydrogen no change appears; but if any arsenical compound is placed in the flask a lemon-yellow spot appears, which gradually deepens to a pale yellowish brown. Antimoniuretted hydrogen produces a brownish grey spot, quite distinct from the arsenical colouration. The reaction is exceedingly delicate.—*Comptes Rendus.*

ON THE EFFECTS OF MAGNETISATION IN CHANGING THE DIMENSIONS OF IRON AND STEEL BARS, AND IN INCREASING THE INTERIOR CAPACITY OF HOLLOW IRON CYLINDERS.*

By ALFRED M. MAYER, Ph.D.,
Professor of Physics in the Stevens Institute of Technology.

(Continued from p. 60.)

On the Elongations and Retractions observed in the Iron Rods as the Strength of the Magnetising Current is Gradually Increased and Diminished, and on the Equality in the Elongations produced by a Definite Current when it is Gradually and when it is Suddenly brought up to its Maximum Strength.

The observed sudden elongations taking place in an iron rod at the moment of its magnetisation naturally led me to inquire if the quantity of this elongation was in any way due to the suddenness of the magnetising action, and whether the elongation produced by a certain current which is gradually brought up to its maximum strength would equal that produced by the same current suddenly passed with the same maximum strength. This problem was also connected with a proposed simple and accurate means of measuring the changes in dimensions of bodies subjected to magnetisation, and I have therefore examined it with care in the following manner:—I cut the thick copper wire leading from the battery to the helix, and firmly attached one of its loose ends to a support. Between this copper wire and the opposite wall I stretched a fine wire of german-silver. The other loose end of the battery wire was bent into a sharp angle, and the vertex of this angle was well amalgamated. Now, by sliding this bent copper wire along the fine wire of german-silver toward the other copper wire, I could gradually diminish the resistance, and on touching the other end of the thick battery wire, this interposed resistance vanished, and the current gained its maximum strength. On slowly retracing our steps the resistance was gradually increased, until the whole length of the fine wire was interposed, and then the resistance was at its maximum and the strength of the current was at its minimum. But, if we brought the two amalgamated ends of the copper wire in contact, either with or without the intervention of a mercury cup, we at once could suddenly send the current with its maximum intensity through the helix.

Mean Results of First Series of Experiments. Resistance of Fine Wire = 0·6 ohm. One cell in circuit.
On gradually diminishing the resistance.

Fraction of length of fine interposed wire.

	1	$\frac{3}{4}$	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{8}$	0
Scale-readings went from 54·8 to	54·85	54·9	55	55·2	55·6	56·1

On gradually increasing the resistance.

Scale-readings went from 55·5 to	54·8	55·6	55·8	55·9	55·95	56·1
Tangent galvanometer	4$\frac{3}{4}$°	—	—	—	—	29$\frac{1}{4}$°

Mean Results of Second Series of Experiments. Resistance of Fine Wire = 0·9 ohm. One cell in circuit.
On gradually diminishing the resistance.

Scale-readings	54·8	54·8	54·85	55	55·4	56·1

On gradually increasing the resistance.

Scale-readings went from 55·25 to	54·8	55·4	55·65	55·8	55·9	56·1
Tangent galvanometer	—	3°	—	—	—	29$\frac{1}{4}$°

Examining the results in the two series of experiments, we see that where the current was passed, with all of the interposed resistance in the circuit, the scale went from 54·8 to 54·85, or moved 0·05 of a division in the first series

of experiments; but in the second series the current was too feeble to effect a measurable elongation, and it was not until $\frac{1}{4}$ of the fine wire was out of the circuit that the scale-reading began to increase. In both series of experiments, the rapid increase in the rate of elongation is noticeable after $\frac{3}{4}$ of the fine wire was out of the circuit; the elongation, in both series of experiments, amounted to 1·3 divs. of the scale. The same amount of elongation always occurred when the ends of the copper wires were brought together, or when the circuit was as suddenly formed by plunging the wires into a cup containing mercury. Therefore it is well established that a current of a definite strength will produce the same amount of elongation whether that strength is suddenly or gradually attained. Indeed, in some of the experiments, over three minutes were occupied in gradually decreasing the interposed resistance, until it was entirely out of the circuit, yet during this very slow increase of the current strength the scale slowly and smoothly moved upward in its readings, and when all the interposed resistance had been passed over the elongation again equalled 1·3 divs.

The establishment of the above fact was of considerable importance, for it rendered applicable the following simple and precise method of measuring the change in dimensions of bodies on their magnetisation. Two iron, steel, or bismuth bars are placed parallel to each other, in V's, with their similar ends strongly pressed against a firm support, so that if the rods change their length on magnetisation, their free ends will move.

Now, imagine a lever so arranged that one end of it carries a plano-convex lens, and the other end a micrometer-screw. The convex side of the lens is opposite a plane-glass, which terminates the end of one of the rods, while the point of the micrometer-screw touches the end of the other rod, against which it is pressed by a spring. An inclined piece of plane-glass placed in front of the lens sends the light from a sodium-flame down to the lens and plane glass behind it, and by means of a microscope we can look through the inclined glass on to the lens, and thus accurately view and measure the Newton's rings, which we will now observe. If around the rods we now pass a voltaic current of gradually increasing strength, we will see the rings gradually displaced, and from the amount and direction of this displacement, together with the knowledge of the wave-lengths of the rays of the sodium light, we can accurately determine the amount and direction of the motion of the ends of the rods.

If, however, the current should have been passed at once with its full intensity, there would have followed a sudden displacement of the rings, but the amount and direction of this displacement it would have been impossible to determine. By making the arm of the lever which carries the convex lens longer than the arm which carries the screw, we can increase the delicacy of the apparatus, for it is understood that, as the rods move in the same direction, the rod carrying the plane-glass moves toward the lens, while at the same time the other rod, through the intervention of the lever, pushes the lens toward the plane-glass.

The examination of the experiments of the first and second series contained under the heading "On Gradually Increasing the Resistance," makes known a remarkable phenomenon. In these experiments, the current, with its maximum strength, was first passed through the helix, and then it was gradually brought down to its minimum strength by sliding the copper battery wire over the fine wire of german-silver until the whole length of the latter was brought into the circuit. At the moment of sending the current with its maximum strength, the rod elongated 1·3 divs. of the scale; but if we now keep the circuit closed, but gradually diminish the strength of the current, we observe that the scale-readings do not correspond to those given when the corresponding strengths of current were reached by going from their minimum to their maximum, as the following tables, giving the differences of scale-readings in the two cases plainly show:—

First series of experiments.

Fraction of length of fine interpolar wire	1	$\frac{3}{4}$	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{8}$	0
On gradually diminishing the current	55·5	55·6	55·8	55·9	55·95	56·1
„ increasing „		54·85	54·9	55·0	55·2	55·6	56·1
Differences		0·65	0·7	0·8	0·7	0·35	0·0

Second series of experiments.

Fraction of length of interpolar wire..	1	$\frac{3}{4}$	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{8}$	0
On gradually diminishing the current	55·25	55·4	55·65	55·8	55·9	56·1
„ increasing „		54·8	54·8	54·85	55·0	55·4	56·1
Differences		0·45	0·6	0·8	0·8	0·5	0·0

We thus see that the rod tends to persist in the elongation it acquired in first passing the maximum current, for it does not retract in proportion to the diminished strength of this current; and the experiments show that even when the current is so far diminished in strength that it would, if suddenly thrown through the helix, be unable to elongate the rod sufficiently to be measurable, yet this feeble current holds the rod elongated 0·45 of a div. in the second series of experiments, but on breaking the circuit the rod instantly retracts 0·45 of a div in the second series of experiments and 0·65 of a div. in the first series, and regains the length it had before the current was passed around it.

On passing the current with the whole of the fine wire in the circuit, we have, in the first series of experiments, an elongation of 0·05 of a div., but, on making the circuit without the interposed fine wire, we have an elongation of 1·3 divs.; and if we now do not break the current, but gradually diminish its strength by increasing the interpolar resistance, we find that when the whole of the fine wire is again in the circuit, that the elongation is yet 0·65 of a div.; whereas, when the circuit was at once formed with this same interposed resistance, the rod was elongated only 0·05 of a div.

The discovery of this most remarkable phenomenon was contained in the above experiments, but, to be sure that my experiments should not mislead me, I repeated them several times, using every precaution to ensure their accuracy, and obtained results almost identical with those formerly observed. I am, therefore, confident that I have discovered a phenomenon worthy of minute study, and I purpose to make it the subject of a special investigation.

Unfortunately, during the above experiments, I did not make a parallel series of determinations of the magnetic intensities of the rod during the successive stages of passing a current of increasing and of decreasing strength. Yet I can hardly believe that the magnetic intensity will be kept up with the persistent elongation of the rod when it is slowly demagnetised, but I think it will be found that the magnetic intensity of the rod depends alone on the strength of the current traversing the helix. The phenomenon, indeed, shows that the molecules of the rod, on its elongation by magnetisation, having been forced into new positions, that either by what might be well called a "magnetic set,"* or from molecular friction, the molecules retained these new positions with such persistence, that it required the sudden shock of the induced current, produced on breaking the circuit, to cause them to rush to their positions of stable equilibrium.

Effects observed on Making and Breaking Separate Currents in the Component Helices of the Compound Helix.

In these experiments two batteries were used. In the outer helix I made and broke a current from 16 cells, arranged four coupled and four in series. In connection with the inner helix, I used a battery of 25 cells, connected five in a row and five in series. The experiments are interesting as showing the effects of the induced currents formed on making and breaking the circuits in the various manners given in the following experiments:—

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* The term "magnetic set," as applied above, is, from analogy, an appropriate name for the phenomenon; but it cannot well be so applied, for Dr. Joule has already appropriated "magnetic set" as designating the residual magnetism an iron rod retains after its electro-magnetisation.

(1). Made circuit in inner helix, rod elongated 1·4 divs.
　　　　,,　　　,,　　outer　　　,,　　　,,　　0·25　,,
　　Broke　　,,　　　,,　　　,,　　retracted 0·25　,,
　　　　,,　　　,,　　inner　　　,,　　　,,　　1·4　　,,

(2). Made circuit in outer helix, rod elongated 1·5 divs.
　　　　,,　　　,,　　inner　　　,,　　suddenly retracted
　　0·4 div., and then suddenly elongated 0·4 div.
　　Broke circuit in inner helix, rod suddenly retracted
　　0·4 div., and then suddenly elongated 0·4 div.
　　Broke circuit in outer helix, rod retracted 1·5 divs.

(3). Made circuit in inner helix, rod elongated 1·4 divs.
　　　　,,　　　,,　　outer　　　,,　　　,,　　0·25　,,
　　Broke circuit in inner helix, rod suddenly retracted
　　0·35 div., then suddenly elongated 0·35 div.
　　Broke circuit in outer helix, rod retracted 1·65 divs.

(4). Made circuit in outer helix, rod elongated 1·5 divs.
　　Made circuit in inner helix, rod suddenly retracted
　　0·5 div., then suddenly elongated 0·05 div.
　　Broke circuit in outer helix, rod retracted 0·1 div.
　　　　,,　　　,,　　inner　　　,,　　　,,　　1·4 divs.

On the Times Occupied in the Elongations and Retractions of a Rod when the Two Component Helices are Joined as One Helix, and Placed in the Circuit of One Battery.

The determinations I here give were made with the eye and a chronograph, and although not as accurate as the interest of the research demands, yet are near enough to the truth to show that the subject is worthy of a careful investigation. The experiments given under the above heading and the succeeding one give an insight into the *velocities* of the molecular motions, and therefore these determinations, taken in connection with the measures of the corresponding elongations and retractions, will be of considerable theoretic interest, when they have been deter· mined with the precision which the following proposed apparatus will, in all probability, afford.

I thus propose to attack this problem. The mirror of the apparatus will be made of the minimum weight consistent with stability. The mirror will reflect a pencil of light from an electric lamp to a revolving glass disc coated with sensitised collodion. This converging pencil will form a dot of light on the disc, and when the latter is stationary will, on the elongation of the rod, describe a portion of one of its radii, which will appear on developing the sensitised plate. If, however, the disc has an uniform and known rate of rotation, the dot will, on the elongation of the rod, describe a curved line which, referred to the appropriate ordinates, will give not only the time of the motion of elongation, but also the mode or law of this motion. Of course the motion of retraction can be studied in like manner.

The following experiments were made on rod No. 3, of English refined iron, and each result is the mean of fifty experiments:—

		Time of Elongation.	Time of Retraction.
(1).	25 cells ..	$\frac{2}{10}$th of a second.	$\frac{13}{10}$ths of a second.
(2).	One cell ..	$\frac{3}{10}$ths ,, ,,	$\frac{1}{10}$th ,, ,,

It is thus seen that, with 25 cells, the duration of the retraction is six times as long as the duration of the elongation, but with a current of one cell the phenomena are reversed, and the duration of the elongation is three times that of the retraction.

Determinations of the Times Occupied in the Elongation and the Retraction of a Rod when the Inner or the Outer Helix forms in itself a Closed Conductor, while the Current is Passed, in the respective cases, in the Outer and in the Inner Helix.

(1). Terminals of inner helix *not* joined. Current passed through the outer helix from 25 cells. Elongation of the rod, 1·5 divs. Times of elongation, $\frac{1}{20}$th of a second. Times of retraction, ¼ sec.

(2). Same result as above when the outer helix was open, and the current was passed through the inner helix.

(3). The terminals of inner helix united; so that this helix formed a closed circuit in itself. Current from 25 cells passed through outer helix. Elongation, 1·5 divs. Time of elongation, $\frac{2}{10}$ths of a second. Time of retraction, $1\frac{1}{10}$th seconds.

(4). Same results as above when the terminals of the outer helix were united, and the current passed through the inner helix.

(5). One cell used. When the terminals of the outer or inner helix were *not* united, and the current passed respectively through the inner and outer helix, the elongation was 1·1 divs. The time of elongation, $\frac{3}{10}$ths of a second. The time of retraction, $\frac{2}{10}$ths of a second.

(6). One cell used. The terminals of inner helix united. The elongation was 1·1 divs. Time of elongation, $\frac{6}{10}$ths of a second. Time of retraction, $1\frac{3}{10}$ths seconds.

(7). Same result as experiment (6) when the terminals of outer helix were joined, and the current from one cell passed through the inner helix.

To observe a rod slowly retracting during 1·3 of a second was a most remarkable sight, and suggests many thoughts as to the interaction of the induced currents passing in the helices and rod. I may here venture to suggest that the study of these extraordinary phenomena—which I believe I have here first made known—will eventually be of some service in the study of induced currents. For the present, I am content with merely presenting *the facts*, for I have not yet been able to command the time which their investigation will require.

In experiments (3) and (6) the time of retraction was, respectively, $1\frac{1}{10}$th seconds and $1\frac{3}{10}$ths seconds, and the slowness of these motions allowed me to obtain an insight into their character. In each of these experiments the rod retracted with a gradually diminishing velocity, and the motion reminded one forcibly of that pertaining to a body projected vertically upward.

(To be continued.)

CORRESPONDENCE.

ON COMMERCIAL ANALYSES.

To the Editor of the Chemical News.

SIR,—I had not intended to notice the remarks of Messrs. Teschemacher and Smith in CHEMICAL NEWS, vol. xxix., p. 280, because the personality carries its own condemnation; but, as in a former case with Mr. Tatlock, these gentlemen have misconstrued my silence, and have re-published and largely circulated these personalities in the assuming form of a *scientific paper*.

We have shown that one of the processes employed by these gentlemen is inaccurate; they have yet to show that it is accurate. With regard to the disputed cargo of coprolites, I can only say that my examples were given me by a superphosphate maker; and, as he worked up the cargo, he should be an unquestioned authority as to which analysis was right. As to the publication of our private letters, although I can have no objection, I fear your readers would dislike to see the columns of your scientific paper defaced with letters even more personal than those you have already published from the same source.

As to the general question, Sir, that is now out of the range of Mr. Teschemacher and myself; your stirring leaders have induced the country at large to take it up, and my slight treble note of warning has been drowned in the deep base roar of my countrymen. An angry public voice has been heard, which will not be silenced until the scandal of "high and low chemists" and incompetent Public Analysts has been for ever swept away. Mr. Tatlock has informed you of the resolution passed by the Glasgow Philosophical Society, and I would add that the Newcastle Chemical Society held a special meeting to consider this question, and passed the following resolutions:—" That this Society desires to support the recommendation of the

Chemical Section of the Glasgow Philosophical Society, as to the methods employed in chemical analysis, and that a communication to that effect be forwarded to the Secretaries of the Section. They also recommended that the following substances should be included in the investigation:—Copper, soda, potash, sulphur, superphosphates, and other manures. The following resolution was also passed:—"That this Society is of opinion that the subcommittee suggested might also usefully inquire into the question of instituting a professional examination for a diploma, without which no person should be legally qualified as a Public Analyst." Thus almost exactly forestalling the resolution adopted at the late meeting of Public Analysts in London.

Although Mr. Teschemacher accuses the "hazy writers of Newcastle" of "incompetency," and disbelieves the importance of the city of Glasgow as a producer of potash salts, I can assure him that the chemical manufacturers of both these cities are not behind the age, and they are determined to have rigid accuracy in commercial analyses, and they will attain that accuracy regardless of any amount of ink which may be thrown over them.—I am, &c.,

EDWARD C. C. STANFORD, F.C.S.,
President of the Chemical Section of the Glasgow
Philosophical Society.
Carruth, Bridge of Weir,
August 17, 1874.

MR. TATLOCK'S REPLY.

To the Editor of the Chemical News.

SIR,—After a six years' silence, Mr. Tatlock has noticed a memoir of ours, "On the Estimation of Potash," you favoured us by inserting in the CHEMICAL NEWS, of May, 1868.

He now charges us with condemning his process:—"Messrs. Teschemacher and Smith took it upon themselves to condemn the process as described by us." Doubting the accuracy of this statement, we, not trusting to our memory, have re-perused this memoir of ours, and would fain ask Mr. Tatlock to do the same. Should he so far favour us, he will be the first to perceive the injustice of his charge, and to admit that we did not condemn his process.

We condemned, not his process, but his conclusion that pure platinum was requisite to determine potash. We denied it then, and we deny it now.—We are, &c.,

E. F. TESCHEMACHER and J. DENHAM SMITH.

London, August 21, 1874.

[This correspondence must now close.—ED. C.N.]

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, No. 1, July 6, 1874.

Researches on Solution, Crystallisation, Precipitation, Dilution.—M. Berthelot.—This interesting paper does not admit of useful abstraction.

Spectrum of the Comet of Coggia.—P. Secchi.—On June 18 and 19 the spectrum with the bands of carbon was considerably developed, the green band remaining the most distinct, whilst in the comet of Temple the yellow was brightest. This proves that the gaseous compounds are not the same in all comets. At the beginning of the month there was merely a spectrum of bands, now there is a general connecting line which unites them into one continuous spectrum. The bands of the comet are more diffuse than those of carbonic oxide. They resemble the spectrum obtained by the electric spark in the vapour of benzine.

Photographic Apparatus Adopted by the Commission for the Transit of Venus.—A reclamation of priority.

Helioscope.—M. Prazmowski.—The author describes the construction of a new helioscope. He remarks that the idea of employing the polarisation of light in place of coloured glasses to diminish the lustre of the sun is not novel; but the quantity of light reflected, even under the Brewsterian angle for glass of a low index ($n = 1.5$) is so considerable that the eye cannot support the light. The author obviates this difficulty by taking a rectangular prism of an index, n, and cementing upon its hypothenuse another similar prism, so as to form a cube. The index of the second prism is n'. A ray of light meets in its course the first hypothenuse of the cemented pair with an incidence of $45°$; this is the surface whose index is $\frac{n}{n'}$. As $\frac{n}{n'}$ is very nearly unity, the angle of $45°$ is very near the Brewsterian incidence. The instrument has been further modified by Janssen.

Diffusion of Light, and the Illumination of Transparent Bodies.—J. L. Soret.—The author has examined if a perfectly homogeneous and non-fluorescent medium can be illuminated by the passage of a pencil of solar light. The possibility of a lateral propagation of light in such cases is contrary to what has been hitherto admitted on the undulatory theory. Most fine specimens of hyaline quartz, pure enough to be employed in the construction of prisms, are not perfectly homogeneous, and when traversed by a pencil of solar light they display the phenomena of illumination. The trace of the rays is very visible—completely polarised. On examining this trace it is generally found due to diffusion, either in consequence of slight defects of crystallisation, or to minute cavities. Some very pure and rare specimens are free from the power of illumination. Yellow quartz (common topaz) is strongly illuminated; the trace of the luminous pencil is blue, and presents a complete polarisation. When a pencil of rays, previously polarised, is caused to pass in the direction of the crystallographic axis, the beautiful experiment of M. Lallemand upon liquids possessing rotatory power is reproduced upon a small scale. A very pure specimen of amethyst was found completely void of illuminating power. Smoke-quartz is in general far from homogeneous. These observations appear to prove that the power of illumination only springs from deficient homogeneity.

Formation of Solar Spots.—M. Tacchini.—A reply to the last note of M. Faye.

Transmission of Electricity through Woody Bodies.—Th. du Moncel.—The author's experiments show that the conductibility of wood is due in great part, if not altogether, to the presence of moisture.

Analysis of Beers and Malts.—Ch. Mène.—A tabular view of the results of the analysis of certain samples of beer and malt, from the exhibition in the Pavillon du Progrès.

No. 2, July 13.

Observations on the Recent Paper of M. Tacchini, and the Memoir of M. Langley.—M. Faye.—A continuation of the discussion on the structure of the solar photosphere, and on the cyclonic theory of spots in the sun.

Chemical Actions, other than Metallic Reductions, Produced in Capillary Spaces.—M. Becquerel.—Capillary communications between two liquids give rise to chemical action, and to effects of diffusion, endosmose and exosmose, as well as to electro-capillary currents, which are so many causes capable of exciting chemical action. The electro-capillary currents are merely con-

cerned in the reduction of metals from their solutions when the electro-motive force is great. If it is less, oxides and compounds of oxides result, and below a certain limit affinities and other causes act alone. If the electric force is considerable, as in case of alkaline sulphides and metallic salts, metallic reductions appear, a fact inexplicable from mere affinity, since the mixture of such liquids would yield metallic sulphides. Split tubes, which produce good results in experiments of reduction, are unfit for the formation of oxides. In these cases it is better to employ tubes closed with parchment paper, or dry collodion. Phenomena of endosmose and exosmose are rarely manifested in these experiments. In explaining the effects produced we must take into account the affinities, the action of the electro-capillary currents, the effects of endosmose and exosmose, and likewise the transportation of matter from the positive to the negative side of the septum effected by the electro-capillary currents. The author has obtained hydrated oxide of copper in blue, double-refracting, acicular crystals; oxides of lead, zinc, cobalt, and nickel, &c.; silicate of lime in tubercles composed of doubly refractive microscopic crystals; crystals of alumina, which, however, are not hard enough to scratch glass; a crystalline and doubly refractive aluminate of magnesia; crystalline and hydrated peroxide of iron; crystalline oxide of manganese; silicate of alumina; and a basic chromate of lead, having the composition of melanochroite.

Chemical Achromatism.— M. Prazmowski.—Considerations on the construction of objectives for photographic cameras, so that the most luminous part of the spectrum may coincide with that portion where chemical action is most powerful.

Second Note on the Electric Conductivity of Wood.—M. Th. du Moncel.—The author finds that the conductivity of wood undergoes all the changes which affect the hygrometer, but that these variations are much more slow in one case than in the other. The conductivity of wood is greatest at 6 a.m., and attains its minimum at 6 p.m., whilst the daily hygroscopic maximum and minimum fall about 3 a.m. and 3 p.m.

Indications Furnished by Conjugated Thermometers in a Vacuum.—M. Marié-Davy.—This paper is an examination of actinic action as one of the principal elements of a climate as regards its action upon vegetation. The author finds that, so far, the present year differs little in mean temperature from the year 1873, but greatly exceeds the latter in its actinometric mean. He considers that the great amount of light is connected with the early maturity and good condition of cereals this year.

Action of Heat upon the Carbides Isomeric with Anthracen, and upon their Hydrides.—M. Ph. Barbier. —The author finds that the three isomeric carbides— anthracen, phenanthren, and tolan can be formed with toluen. He has not succeeded in directly transforming any of these into the others. Of the three isomeric hydrides, benzyl yields, in the moist way, tolan, and in the dry way phenanthren; liquid tolyl yields anthracen with a notable proportion of phenanthren; benzyl-toluen yields anthracen with a trace of phenanthren.

Analysis of Samples of Wines from the Exhibition in the Pavillon du Progrès.—Ch. Mène.—A tabular view of the percentage of alcohol and saline matter, of the syrupy residue per litre, and of the specific gravity of the samples.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 10, June 22, 1874.

Influence of Light upon Cinnabar.—K. Heumann. —The author finds that cinnabar prepared in the moist way, by digesting penta-sulphide of ammonium, is decomposed by light much more rapidly than the sublimed variety. The intensity and speed of the blackening depend on the nature of the supernatant liquid. Cinnabar

prepared in the moist way is not blackened at all if covered with a layer of dilute nitric acid. Under pure water the change is very slow, whilst it is greatly accelerated by the presence of an alkaline liquid, especially ammonia.

Desulphurisation of Cinnabar at Low Temperatures.—K. Heumann.—To detect metallic mercury in commercial cinnabar (vermillion) the author rubbed the samples with water upon bright sheet copper, in the opinion that free mercury would be detected by the appearance of amalgamation. As the copper became amalgamated in every case, whilst no mercury was dissolved out of the samples by dilute nitric acid, it became apparent that copper is capable of decomposing cinnabar. On boiling cinnabar in water with powdered copper the red colour of the mixture disappears, and is succeeded by a black-grey, from the production of sulphide of copper. Powdered zinc had a more energetic action, though here also the sublimed variety appeared more stable than that formed in the moist way.

Communications from the Laboratory of the University of Louvain.—Louis Henry.—These communications consist of a hypothetical paper on lactid; an account of the addition-products of hypobromous acid with the allyl compounds, and of the triple glycerin derivatives, $C_3H_5XX'X''$; on chloro-brom-propionic acid; on the preparation of the acetylous hydrocarbons; on the radical propargyl; and on the alcohol derivatives of chloral.

Preparation of Iodide of Potassium from Cuprous Iodide.—G. Langbein.—Cuprous iodide, which now arrives in considerable quantities from Peru, containing from 60 to 66 per cent of iodine, is a cheap and convenient material for the preparation of pure iodide of potassium. In the following process the outlay is covered by the secondary products:—The cuprous iodide is freed from soluble matters by washing, and is then suspended in water in the state of a fine powder. It is acidulated with a few drops of hydrochloric acid, and treated with sulphuretted hydrogen, with constant agitation, until all the cuprous iodide is converted into hydriodic acid and sulphide of copper. This may be known by the circumstance that the deposit is a pure black, free from white granules of cuprous iodide. Sometimes small quantities of sulphate of lime are present, which may prove deceptive. The entrance of the sulphuretted hydrogen gas is then stopped. Any excess of this reagent is decomposed by adding iodine dissolved in iodide of potassium, the mixture well stirred up, and the sulphide of copper allowed to settle. The solution of hydriodic acid, which is still somewhat turbid owing to precipitated sulphur, is drawn off, the residue well washed with water, and the washings used instead of water in the next operation. The hydriodic acid is now neutralised, either with potash lye or bicarbonate of potash, and evaporated to crystallisation. During the evaporation the sulphur coagulates, and settles to the bottom of the vessel. The solution of iodide of potassium, when it has arrived at the proper degree of concentration, is strained off into crystallisers perfectly free from sulphur. From 2·177 grms. of the ore, containing 66 per cent of iodine, or 1·436 grms., were obtained 200 c.c. of a solution of iodide of potassium, containing 1·428 grms. of iodine. The loss was therefore merely 0·008 grm. The very pure sulphate of iron covers the cost of acid, and sulphide of iron, and the blue vitriol formed by roasting the sulphide of copper, equals in value the amount expended for bicarbonate of potash, fuel, and labour.

Tri-Cyan-Hydrogen—a Polymer of Hydrocyanic Acid.—R. Wippermann.—The compound in question was accidentally obtained on heating hydrocyanic acid, and epichlorhydrin together in a sealed tube.

Existence of Definite Hydrates in the Aqueous Solutions of Acids.—Julius Thomsen.—A thermochemical paper. The author, in opposition to Berthelot, denies the existence of such hydrates.

On Guanamin.—M. Nencki.—An account of the properties and composition of guanamin, $C_4N_5H_7$; and of its hydrochlorate, platino-chloride, nitrate, sulphate, and acetate.

Sulphurea Oxalic Ether.—M. Nencki.—This compound, obtained by mixing oxalic ether with an alcoholic solution of sulphurea has the composition—
$$(CSN_2H_4)_2C_2O_2(C_2H_5O)_2.$$
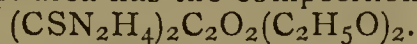
On Laureo-Stearin.—Hugo Schiff.—This substance was first analysed by Marsson in 1842. Its composition may be expressed by the formula $C_{27}H_{50}O_4$. The author regards it as a tri-acid derivative of glycerin.

On Chrysochinon.—C. Graebe.—Chrysochinon corresponds to phenanthren-chinon, and not to anthrachinon. With acid sulphites of the alkalies it forms colourless compounds soluble in water. If dry chrysochinon is treated with a solution of the acid sulphite of soda it dissolves with great difficulty, but it is totally soluble at a gentle heat if previously moistened with alcohol. Stronger acids precipitate chrysochinon from its solutions in the shape of orange microscopic needles. If heated to 180° in a sealed tube with aqueous ammonia it is converted into a nitrogenous body.

Nitrol Acids.—Victor Meyer and J. Löcher.—The authors treat of the spontaneous decomposition of propyl-nitrolic acid, and of a product obtained from the reaction of pseuco-nitro-propan and nitrous acid.

Constitution of Nitro-Butan.—Eugen Demole.—Not suitable for abstraction.

Communications from the Laboratory of the University of Gottingen.—H. Hübner.—These consist of papers on thihydro-benzoic acid, dithio-benzoic acid, and brom-thihydro-benzoic acid, by F. Frerichs; on meta-brom-toluol, by E. A. Grete; on α-para-chlor-sulphi-toluol, and nitro- and amido-para-chlor-toluols, by A. Englebrecht; on certain compounds of lanthanum and didymium, by F. Frerichs. This chemist separates the oxides of lanthanum and didymium by two methods. The first process consists in heating the mixture of the two oxides in a current of chlorine gas, adding water to the mixed oxychlorides thus obtained, and setting the whole aside in a warm place. If so much lanthanum was present that three equivalents of it entered into reaction for every six of didymium, the solution, after prolonged digestion, contained merely chloride of lanthanum, whilst the deposit consisted of a mixture of hydrous oxide of didymium and oxychloride of lanthanum. If didymium was present in larger proportion, a product was obtained rich in lanthanum, which yielded a pure preparation on repetition of the process. In the second method, the mixture of both oxides was dissolved in nitric acid, and to the solution so much of a standard sulphuric acid was added that not quite all of the lanthanum was converted into a sulphate. After standing for several days all the sulphuric acid was found combined with the lanthanum, as the more positive of the two metals. The nitrate was decomposed by evaporation and gentle ignition, and the sulphate alone extracted in water. To obtain pure compounds of didymium so much sulphuric acid was added to the solution of the mixed nitrates that all the lanthanum and a part of the didymium were converted into sulphates. On evaporating and igniting gently a mass was obtained, from which water withdraws all the lanthanum and a part of the didymium in the state of sulphates. The residue when dissolved in sulphuric-acid furnishes a pure sulphate of didymium. The Gottingen communications further contain a paper by F. Frerichs on the separation of barium from strontium, calcium, and magnesium by means of neutral chromate of potash.

Separation of Barium and Strontium.—Well crystallised nitrates of baryta and strontia, finely powdered, were exposed for two to three hours to a temperature of 80° or 90° in the drying closet. Small amounts of the dried salts were weighed, dissolved in water, mixed with acetate of soda and acetic acid in excess, and so much of a solution of neutral chromate of potash added. After standing for some hours the precipitate was filtered and ignited. The results were—

	Calculated.	Found.
Ba	$0·2134 = 24·63$ per cent	$0·2135 = 24·64$
Sr	$0·1901 = 21·94$,, ,,	$0·1900 = 21·93$

Barium is separated from calcium in a manner quite analogous. The lime in the filtrate was first thrown down with ammonia and carbonate of ammonia, boiled for some hours, filtered, the precipitate dissolved in hydrochloric acid, and the lime re-precipitated from this solution by means of ammonia in excess, and oxalate of ammonia. Direct determination of lime by oxalate of ammonia in presence of chromate of potash was not successful. The separation of barium from magnesium was satisfactory.

Palladio-Chloride of Aluminium.—A. Welkow.

Palladio-Chloride of Beryllium.—A. Welkow.—Accounts of the composition and chemical properties of these salts, with a crystallographic description of the former.

Synthesis of Anthrachinon-Sulphuric Acid.—C. Liebermann.—If β-benzol-benzoic acid is heated for some time with fuming sulphuric acid till water no longer produces a precipitate in the mixture, it is converted into anthrachinon-sulphuric acid. Alizarin prepared from this acid possessed its ordinary properties.

Rectification.—C. Liebermann.—In a former communication the author stated that the series of colouring matters formed from the phenols by treatment with nitrous sulphuric acid had no affinity for animal fibres, and did not appear suitable for dyeing. This statement is correct if the experiment is tried in an aqueous or slightly alkaline bath. In dilute alcoholic, slightly acid solutions, or in alkaline solutions mixed with an excess of acetic acid, they dye silk, producing in some cases good colours. The tinctorial bodies obtained from phenol, cresol, and resorcin give shades from olive to buff, the orcin compound a fine orange, and the thymol a violet.

On Suberon.—C. Schorlemmer and R. S. Dale.—Not adapted for abstraction.

Explanation.—Gorup-Besanez.—In reference to imperatorin and ostruthin (see *Berichte*, No. 9).

Action of Nitrous Acid upon Dimethylanilin.—A. Baeyer and H. Caro.—The authors are of opinion that they have obtained the long-sought-for nitrosophenol, a body soluble in water, turning orange on the addition of alkalies. In alkaline solutions it is stable, but in presence of acids easily decomposed. Concentrated hydrochloric acid, at a gentle heat, reacts so violently that the mixture boils. Tin and hydrochloric acid readily decolourise the brown solution. Nitrosophenol cannot exist in presence of nitric acid.

Phenyldiamin as a Secondary Product of the Manufacture of Aniline.—A. W. Hofmann.—Reserved for insertion in full.

Desulphurisation of the Phenyl-Mustard Oil.—A. W. Hofmann.—A reply to Weith's paper, *Berichte*, vii., 722.

Polytechnisches Journal von Dr. E. M. Dingler,
Band 210, 3.

Fabrication of Cast-Steel according to the Procedures of Bessemer and Martin-Siemens.—Noblet.

New Process for Hardening Steel, and on the Restoration of Burnt Iron.—H. Caron.

Determination of Sulphur in Cast-Iron, Wrought-Iron, and Steel.—M. Koppmayer.

Application of Bisulphate of Potash for the Recognition of Galena in Mixed Ores.—E. Jannetaz.

Utilisation of Platinum Residues.—Th. Knösel.

Alizarin as an Indicator in Titration.—Eng. Schaal.

Use of the Bog Iron Ore of Budin (Bohemia) for Purifying Coal-Gas.

Band 210, 4.

Rapid Colorimetric Method for Determining the Manganese in Pig-Iron, Steel, Iron, and Ores.—Aug. Brunner.

Qualitative and Quantitative Examination of Chromate of Lead for Adulterations.—G. C. Witstein.

Carbonic Acid of the Atmosphere.—P. Truchot.

Examination of Potable Waters.—Ferd. Fischer.

Presence of Copper in Water which has passed through Copper Tubes.—E. Reichardt.

Occurrence of Arabinic Acid in the Sugar-Beet, and on Arabinose.—C. Scheibler.

Band 210, 5 and 6.

Contribution to the History of the Alloys of Manganese.—v. Schroeter.

Manufacture of Alum in Montioni.—Kurtz.

Qualitative and Quantitative Determination of Hypochlorous Acid in Presence of Chlorine, Chlorous, and Chloric Acids.—Walters.

Process for Determining the Percentage of Aniline Colours by Means of the Hydrosulphite of Soda.—Stamm.

Uses of Soap in Textile Manufactures.—Vohl.

Examination and Composition of Extract of Meat.—E. Reichardt.

Manufacture of Meat-Flour.—Hulwa.

Influence of Beet-Gum (Arabinic Acid) upon the Manufacture of Beet-Root Sugar.—Scheibler.

Articles made from Fats at the Vienna Exhibition.—Schwartz.

Limousin's Apparatus for Evolving Oxygen for Medical Purposes.—Hildwein.

Action, and the Relative Value of Disinfectants.—J. A. Wanklyn.

MISCELLANEOUS.

British Association for the Advancement of Science.—The following is a complete list of the papers which were brought before Section B (Chemical Science) at the Belfast meeting, under the presidency of Dr. A. Crum Brown, F.R.S.E., &c. They will be published, in full or in abstract, according to their importance, in the CHEMICAL NEWS:—

President's Address.

Professor G. C. Foster.—On Siemens's Pyrometer.

Professors Roscoe and Williamson.—Report of Committee for Superintending the Monthly Reports of the Progress of Chemistry.

W. Chandler Roberts.—Report of Committee on Essential Oils.

Professor Hodges.—The Chemical Composition of Jute Fibre.

Professor Brown and Dr. E. A. Letts.—Methyl-thetine.

Dr. C. R. A. Wright.—On some Opium Derivatives.

Professor Corfield.—Report of the Committee for the Utilisation of Sewage.

Dr. Carpenter.—On the Replacement of Organic Matter by Siliceous Deposits in the Process of Fossilisation.

Professor Hodges.—On the Silicified Rock of Lough Neagh.

Professor Roscoe.—On a Self-Registering Apparatus for Measuring the Chemical Action of Light.

Professor Roscoe.—On Certain Abnormal Chlorides.

Professor Thorpe.—On the Specific Volumes of Certain Liquids.

Messrs. Braham and Gatehouse.—On the Dissociation of Nitric Acid.

Professor Andrews.—Experiments at High Pressures.

Dr. Dewar.—On the Latent Heat of Liquefied Gases.

Dr. Dewar.—Report of the Committee on the Estimation of High Temperatures.

Professor Debus.—On Spontaneous Generation, from a Chemical Point of View.

Mr. Ogilvie.—On the Estimation of Phosphoric Acid as Pyrophosphate of Magnesia.

W. Jesse Lovett.—On an Improved Form of Filter Pump.

Professor Emerson Reynolds.—Notes on the Preparation of the Sulphur-Urea.

Professor Emerson Reynolds.—On the Action of the Sulphur-Urea in Metallic Solutions.

Lowthian Bell.—On the Joint Action of Carbonic Acid and Cyanogen, on Oxide of Iron, and on Metallic Iron.

Professor Gladstone and Mr. Tribe.—Electrolytic Experiments on Metallic Chlorides.

W. Chandler Roberts.—Report of Committee on Methods of Making Gold Assays.

Professor Hodges.—Analyses of Indian Teas.

W. J. Cooper.—Composition of Certain Kinds of Food.

Mr. Fairley.—New Reactions of Peroxide of Hydrogen Hypochlorous Acid, and Ozone.

Mr. Fairley.—Hypochlorous Acid and Ozone. Synthesis of Perchloric Acid.

Professor Maxwell Simpson.—On the Chlor-Bromides and Brom-Iodides of the Olefines.

Professor Andrews.—On an Aspirator.

Professor Delffs.—On an Aspirator.

Professor Clifford.—On the General Equations of Chemical Decomposition.

Dr. T. L. Phipson.—On the Presence of Cyanogen in Commercial Bromine, and a Means of Detecting it.

Dr. T. L. Phipson.—On a Sesqui-Sulphide of Iron.

Professor Armstrong.—Report on Isomeric Cresols.

W. Charley.—On the Injurious Effects of " Dew-Rotting " Flax.

P. Braham.—Mode of Producing Spectra on the Screen with the Oxy-Hydrogen Flame.

Professor Crum Brown.—On the Mode of Writing Chemical Equations.

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Place of Meeting for Next Year. — The meeting next year will be held at Bristol. President Elect—Sir John Hawkshaw, C.E., F.R.S. Glasgow has been selected for the meeting of 1876.

ON the day of the opening of the Belfast meeting of the British Association the death was announced of Sir William Fairbairn, Bart., F.R.S. Sir William was one of the founders of the Association, and presided over the meeting held in 1861. He died on the 18th inst., in the eighty-fifth year of his age.

The **Priestley Centennial.**—The meeting of American Chemists to commemorate the discoveries of Priestley, to which we alluded a few weeks ago (see CHEMICAL NEWS, vol. xxx., pp. 17, 31), was held at Northumberland, Pa., on July 31st and August 1st. The following gentlemen were appointed permanent officers :—*President*—Professor C. F. Chandler. *Vice Presidents*—Professor Rachel L. Bodley, Professor J. W. Draper, Professor Silas H. Douglas, Dr. A. H. Gallatin, Professor E. W. Hilgard, Professor E. N. Horsford, Professor J. W. Mallet, Professor S. St. John, Dr. H. C. Bolton, Professor A. P. S. Stuart, Professor T. G. Wormley, Professor Henry Wurtz, and Professor C. A. Joy. *Secretary*—Professor Albert R. Leeds. *Treasurer*—Professor William H. Chandler. *Finance Committee*—Professor T. R. Pynchon, Professor Traill Green, Professor A. P. S. Stuart, Professor H. Wurtz, Professor Persifor Frazer, Professor B. F. Hedrick. *Committee on Resolutions*—Professor B. Silliman, Professor J. W. Mallet, Professor J. E. Smith, Professor William H. Chandler. *Committee on Scientific Papers*— Professor C. A. Joy, Dr. T. W. Drown, Professor F. W. Clarke. *Committee on Telegraphy*—Professors Frazer, Sharples, and Wheeler. Professor J. Lawrence Smith submitted the following resolution, which was carried unanimously :—Resolved, that a committee be appointed to confer with the Committee of the Centennial Exhibition, to correspond with chemists and professors of cognate sciences in Europe, in order to induce as large a representation as possible of them to visit our country in 1876. In pursuance of this resolution the Chairman appointed to act on this committee Professors J. L. Smith, Gibbs, Hunt, Mallet, Joy, Leeds, Bolton, Horsford, Silliman, Barnard, and Barker. Addresses were delivered by Professor H. H. Croft, Professor T. Sterry Hunt, Dr. Henry Coppee, Professor J. Lawrence Smith, Professor Silliman. In future Nos. of the CHEMICAL NEWS we shall give abstracts of these addresses. Mr. Waller moved that the balance deposited by the Treasurer, Professor William H. Chandler, in the hands of the Secretary be expended for a suitable photographic album, and that all the gentlemen who have placed their names on the Treasurer's list are requested to send their *carte de visites* to Dr. H. Carrington Bolton, School of Mines, New York, as also their autographs on a separate paper, which will be inserted below their photographs. It is proposed to present this memorial photographic album to Dr. Joseph Priestley and his family, to be preserved by them and their descendants until the meeting of the next Centennial of Chemistry in Northumberland, Pa., on the 1st of August, 1974. A number of appropriate resolutions were passed, recognising the hospitalities and kindnesses shown by the people of Northumberland to the chemists on the present occasion, after which the meeting was adjourned.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the treatment of wool, silk, and other animal textile materials in a manufactured state. John Henry Johnson, Lincoln's Inn Fields, Middlesex. (A communication from Jean Baptiste Frezon, the elder, Paris). December 6, 1873.—No. 4027. This invention relates to certain improvements on the process described in the Specification of an invention for which Letters Patent were granted to me on behalf of the said Jean Baptiste Frezon, No. 861, 1867, and consists essentially as follows :—First. In the extension of the limits of saturation and of the temperature of the acid baths employed. Second. In the dispensing in most cases with the baths previously employed for preserving the wool from the action of the chemicals used in destroying the vegetable matters, it having been discovered that the wool itself generally contains sufficient fatty matter to preserve it from contact with the action of the acids employed in destroying the vegetable matters mixed therewith. Third. In the special application to silk of the improved process; and lastly, of a process for destroying the vegetable matters, and simultaneously mordanting the fabrics or materials to be dyed or bleached.

Improvements in the treatment and disposal of sewage. Henry Malcolm Ramsay, civil engineer, Amyand Park Road, Twickenham. December 12, 1873.—No. 4092. 1. The purification of sewage as delivered or discharged from the sewers, tanks, pumping-main, or other means, by distribution under the surface of any suitable land through a system of open half-pipe or circular perforated filter-drains, laid in trenches in parallel lines, about 12 feet apart, upon a bed of, and surrounded by, coarse filtering material, the trenches being filled in over to surface-level. 2. The disposal of any portion of the supplies of sewage at option over surface for cultivation purposes. 3. The area of land in each case to be divided into 1-acre plots or thereabouts, the system of filter-drains being laid in sets to each plot distinct, supplied and charged from delivery-conduit or otherwise, as the position of the works or contour of the locality may determine, each plot or set of filter-drains being so charged in rotation, allowing an ascertained time, dependent in each case on the nature of the subsoil, for filtration and absorption, the land being further underdrained in the usual manner at such levels as found desirable. 4. The disposal of sewage at any time of the year, without stoppage from frost or other interruptions, such as occurs in disposal by surface irrigation. 5. The disposal of sewage without creating any surface nuisance or objectionable local results, 1 acre consuming on an average 150,000 gallons at one charge of the filter-drains therein.

Improvements in the manufacture of cement. Major-General Henry Young Darracott Scott, C.B., Ealing, Middlesex. December 12, 1873.—No. 4099. The patentee takes spent lime which has been employed in purifying gas, and adds thereto from 15 to 25 per cent of ordinary clay, in which the siliceous ingredient preponderates.

An improved explosive compound or gunpowder. Joseph Fenton, Colchester, Essex. December 17, 1873.—No. 4148. This white gunpowder is composed of yellow prussiate of potash, loaf-sugar, and chlorate of potash, which are ground fine, and then kneaded to the consistency of dough, after which the compound is dried and passed through sieves of various sizes to obtain different sized grains. This gunpowder is made without any risk, and is more powerful than ordinary powder.

THE CHEMICAL NEWS.

VOL. XXX. No. 771.

ON THE
PREPARATION OF ARTIFICIAL ALIZARIN.
By ADOLPH OTT.

THERE being very little known on the manufacture of artificial alizarin, I suppose that a detailed description of the process employed will be welcome. Of the different methods proposed for the transformation of the anthracen into alizarin, manufacturers now follow generally that which is described in the patent of Graebe, Liebermann, and Caro, dated June 25, 1869. It is based upon the oxidation of anthracen to anthrachinon, the treatment of the anthrachinon with sulphuric acid in order to convert it into the bisulpho-combination, and the melting of the corresponding soda salt with hydrate of soda, whereby alizarin is formed.

Preparation of the Anthrachinon.

With regard to the conversion of the anthracen into anthrachinon, bichromate of potassa and sulphuric acid are generally used; many manufacturers employ also some nitric acid, especially towards the end of the operation. Anthracen and bichromate are intimately mixed together, the sulphuric acid (in dilution) being only gradually added. The operation is conducted in tubs lined with lead, and with the use of steam. By the addition of acetic acid to the mixture, the reaction takes place with less loss of substance, but it is probably only employed when it can be got cheaply. In case acetic acid is used in conjunction with oil of vitriol, the proportions are of course subject to a change. On a small scale I have employed the following process :—1 part of anthracen was mixed with 2½ parts of bichromate of potassa, and to this 4 parts of wood-vinegar were added. After this mixture had been heated for some time, 6 parts of oil of vitriol, diluted with twice their volume of water, were gradually poured in. The operation was conducted on the water-bath, until no further reaction was recognisable. The yield equalled nearly the theoretical one. M. Nienhaus, in Zürich, informs me that he has successfully used the following process :—100 parts of anthracen were mixed with 25 parts of bichromate of potassa, 12 parts of nitric acid of 1·05 sp. gr. being added. A smeary mass resulted, which, if brought into a moment's contact with fuming nitric acid, was rendered granular, like anthrachinon produced in the ordinary manner. In contact with sulphuric acid, the smeary mass developed nitric acid gas.

The anthrachinon prepared from commercial anthracen requires a preliminary purification. To this end, the crude product is dissolved at 70° C. in concentrated oil of vitriol, and left in contact with it until sulphurous acid gas ceases to be disengaged. This operation is conducted in cast-iron kettles. It is then precipitated by water, collected, thoroughly washed, pressed out, and dried at a temperature of 50° C. Thus purified, it forms a greenish grey, impalpable powder.

Preparation of Alizarin.

The first step now consists in the making of the bi-sulph-anthrachinonic acid—

$$C_{14}H_6O_2 \begin{cases} SO_3H \\ SO_3H \end{cases}$$
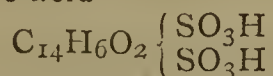
which is obtained by dissolving 1 part of anthrachinon in 4 to 5 parts of fuming oil of vitriol, and heating of the mixture to a temperature of from 270° to 290° C. Hereby it is important to proceed as quickly as possible, because otherwise a large amount of phthalic acid is formed. On a large scale, the operation is completed in two hours.

It is best conducted in cast-iron vessels. Since at so high a temperature considerable quantities of anthrachinon sublime, the vessels are best set in connection with a wooden chamber by means of pipes; there all the anthrachinon is deposited that would otherwise be lost. It has been stated that by the addition of from 1 to 2 per cent of nitric acid, the sublimation of the anthrachinon could be avoided, but this I have found not to be the case. The final product consists of a black, pitch-like, and (if cool) solid mass. This is well exhausted with a large quantity of boiling water; the liquid is then filtered, and the clear slightly yellowish coloured liquid is saturated with chalk, whereby a lime-salt of the bisulpho-acid is formed, sulphate of lime being precipitated. The filtered solution, which now presents a brownish red colour, is decomposed with carbonate of soda, whereby at a moderate heat granular carbonate of lime deposits. The liquid now bears great resemblance to a decoction of Brazil wood. It is syphoned off, evaporated to 20° Baumé, and allowed to cool. What then settles yields alizarin with a bluish shade (*Alizarin mit Blaustich*), and the liquid such with a yellowish tint (*Alizarin mit Gelbstich*). Manufacturers believe that the former consists of the bisulpho-salt, the latter of the monosulpho-salt, but it is more probable that the yellow tint is due to a distinct yellow colouring matter.

In order to convert the sulpho-salt into alizarin, it is brought to a certain specific gravity, and is then treated with hydrate of soda, whereby the following reaction ensues :—

$$C_{14}H_6O_2 \begin{cases} SO_3Na \\ SO_3Na \end{cases} + 2NaOH =$$
$$= C_{16}H_6O_2 \begin{cases} HO \\ HO \end{cases} + 2(Na_2SO_3)$$
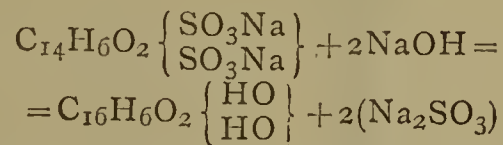
The operation is conducted in cast-iron vessels provided with stirrers, and at a temperature of from 170° to 200° C. The kettles are set into oil-baths, the arms of the stirrers presenting the form of plough-shares; the solid hydrate of soda is only gradually added. If the temperature is exceeded, a re-formation of a part of the bisulpho-salt into anthrachinon, or even into anthracen, can readily take place. These substances are then generally found deposited on the lower part of the cover. As to the time of the operation, it is dependent, of course, upon the quantity of the materials taken, and other conditions, but it seems always to require several days. At the time when the blue colour of the melting mass passes over into a violet-blue, a sample is withdrawn from time to time, and dissolved in water. To the liquid a few drops of sulphuric acid are added. If large quantities of flocculæ separate, it is a sign that the operation is almost or quite complete. The withdrawing of samples is therefore repeated during short intervals. When it is thought that the process is terminated, the contents are dissolved in water, the liquid is poured in wooden tubs, and the alizarin precipitated by means of hydrochloric or sulphuric acid. The precipitate is then washed well in a filter-press; and in order that the alizarin, which now presents itself in very fine flocculæ, remains suspended, it is subjected to agitation in a special apparatus, and then brought into commerce either as *pate* of 15 per cent or as *pate* of 10 per cent.

Berne, Switzerland.

ON A NEW CONSTRUCTION OF A BAROMETER.
By CHARLES H. GIMINGHAM

THE following is a simple method of constructing an accurate barometer for scientific purposes, and is specially adapted to be used in conjunction with the Sprengel mercury air-pump. The advantage consists in the construction of the air trap being so easy that it affords the amateur instrument maker a means by which he can manufacture a very perfect barometer at pleasure.

A piece of tubing (any kind of glass will do, providing

it will stand heating without fracture) 8 or 10 inches long and about 10 millimetres internal diameter; this must be thoroughly cleaned and one end sealed and rounded off in the blowpipe flame, as shown at *a*, Fig. 1. At about 3 inches from this sealed end, the tube is heated in rather a broad blast, turning slowly and evenly all the time; when red-hot and quite soft, remove from the flame and draw out until the bore in the centre (*b*, Fig. 1) is about 1 millimetre in diameter. The tube is now filled with mercury up to *c*, placed inside another tube, and the whole length from *a* to *c* boiled, piece at a time, over a Bunsen's lamp, till no more specks of air are seen between the mercury and the glass. This boiling operation is rather tedious, and generally takes from ¼ to ¾ of an hour. As soon as the boiling is finished, which must be done with great care, and the tube cool, it is cut at *b* with a sharp file, a little mercury forced out by expansion, and when

FIG. 4.   FIG. 3.   FIG. 2.   FIG. 1.

again cool the aperture can be contracted to a capillary bore.

The second part is shown in Fig. 2. *a* is made from the piece of tube *d* (Fig. 1) cut off after boiling *a c*. To form the cup *c* (Fig. 2) the end is closed and a small thick bulb blown, the bottom of which is heated till quite flat, then blown out rather suddenly; the large thin bulb thus made is broken off and the edge of the cup fused round with a pointed flame. A piece of tube of smaller bore is joined on to *a*, and the end cut off so that when the barometer is put together, its length from *a* to *b* (Fig. 3) shall be about 33 inches; then by placing the proper height of mercury in the reservoir the normal pressure can be arranged to stand in the centre of the top part (*a d*).

A plain india-rubber collar is now cut out with cork borers, which is easily done by wetting with caustic pot-

ash; it must be made to fit loosely in the tube *a* (Fig. 2) so that when pressed up to the shoulder (*e*, Fig. 1) it will fit tight and be conical in shape. Before placing the collar on the tube it is heated till quite soft, and the surface inside and out slightly decomposed; this will make the adherence to the glass very perfect.

The second part (Fig. 2) must now be carefully filled with mercury up the cup *c*, best done by suction with the tube in a slanting position, as very little air is enclosed this way, between the mercury and the glass; it is difficult to bring the mercury to more than within a couple of inches of the top by suction, but the wide part (*a*) is easily filled without enclosing air, by means of a long-necked funnel kept below the surface of the mercury. The tube is kept full by pressing the lower end on a piece of india-rubber.

The top part is inverted in the cup, having first expanded the mercury till it oozes out of the capillary aperture. The collar is pressed in as tight as possible, which will cause some mercury to pass into the cup. This must be allowed to remain there in order to make the joint sound, and a ring of cork fitted to the top of the cup to serve the double purpose of keeping the mercury in its place and supporting the top of the barometer. A section of the trap thus formed is shown in Fig. 4.

An extra safeguard against air passing up to the top of the barometer consists in placing a small cup made of a piece of tube sealed at one end over the point of the trap before putting the two parts together (*t*, Fig. 4).

Of course it is well known that all good barometers have a trap of this description which is always blown in the tube. To make a compound joint like this requires very considerable skill at glass-blowing, the great difficulty being to get the joint to stand the long-continued boiling of the mercury; it has been in this part of the operation that most of my blown traps have cracked, and after repeated trials I thought of the plan I have been endeavouring to describe, and can testify to its giving results highly satisfactory, having had a barometer made in this way at work by the side of the gauge of Mr. Crookes's mercury pump for many months.

It may be well to give one or two hints before conclusion with regard to making the joint (*d*, Fig. 2). The tubes *a* and *b* must be of the same glass: I generally use the English lead glass; it is easy to work, and answers quite well. The tube *a* (Fig. 2) after blowing the cup *c* is cut off at about *c* (Fig. 1), so as to leave the aperture about two-thirds of the real diameter of the tube. One end of *b* (Fig. 2) is then expanded to the same size, by making it soft and pressing it out with an iron wire, which must be made hot before touching the glass or the latter will crack. The two are now heated at the tip of a pointed flame and put together; the joint has now to be thoroughly fused all round with a very small pointed flame, but only directing the flame to one part at a time. The glass will be driven in at each point when the flame is directed on it; but this indentation will be expanded again each time by gently blowing in at *c* (Fig. 2) having previously closed the end of *b* with a small piece of cork; when the joint is finished it is well to keep it in a smoky gas flame for some time, till thickly covered with lamp-black, and then allowed to cool.

ON THE COMPOSITION OF TEA AND TEA-SOILS FROM CACHAR.*

By Professor HODGES, M.D., F.C.S.

NOTWITHSTANDING the important place occupied by the tea-plant in the dietary of so large a portion of the world, its chemical examination has attracted comparatively but little attention. We owe to Peligot and Mulder the most valuable investigations which have been made in conection with it; and more recently we have been supplied with

* Read before the British Association, Belfast Meeting, Section B.

some analyses of the ash of teas from the laboratory of Professor Horsford, while Wanklyn and Allen have lately contributed many facts of great value in reference to the examination of the tea of commerce and the detection of adulteration.

Some time ago Professor Zöller read before the Physico-Medical Society of Erlangen a paper on the chemical investigation of a Himalaya tea (*Repertorium für Phar-macie*, Band xx., heft 8), which possessed peculiar value, from the circumstance that the specimen examined might be regarded as consisting of genuine tea without any foreign admixture, having been received from the growers by the late Baron von Liebig. Professor Zöller's investigations confirmed the correctness of observations which he had formerly made respecting the influence which the age of the leaves of plants exercised on the composition of the ash, that while young leaves are rich in potash and phosphoric acid, and poor in lime and silica, the amount of lime and silica in the ash increases with the age of the plant. As the best qualities of tea are known to consist, as I shall presently show, merely of the very young shoots of the plant, the estimation of the amount of potash, phosphoric acid, lime, and silica, may usefully, as he suggested, be employed in enabling us to judge of the quality of a specimen of tea. This opinion he found confirmed by the examination of the specimen of Himalayan tea.

100 parts of the ash of this tea consisted of :—

Potash	39.22
Soda	0.65
Magnesia	6.47
Lime	4.24
Oxide of iron	4.38
Protoxide of manganese	1.03
Phosphoric acid	14.55
Sulphuric acid	trace
Chlorine	0.81
Silica, acid, and sand	4.35
Carbonic acid	24.30
	100.00

The richness of the tea-ash in potash and phosphoric acid, showing that the tea had been prepared from young leaves, suggested that the amount of leaves, soluble in water, and of nitrogen, and also probably of theine, would be large. These anticipations were confimed by the investigations. The extract obtained by treating the leaves with boiling water weighed 36.38 per cent and the nitrogen 5.38 per cent, while the theine amounted to 4.95 per cent of the air-dried leaves.

Some time ago I had an opportunity of submitting to examination specimens of tea grown in Cachar, under the superintendence of Samuel Davidson, Esq., formerly of Belfast, and also a specimen of fine Cachar tea forwarded to me from the same district by Dr. Joseph Nelson. Mr. Davidson's specimens were taken from the fields in August and were carefully enclosed in tin-foil, and may therefore be regarded as representing genuine, unmixed specimens of Indian tea. Mr. Davidson also kindly supplied the following history of the crop from which the specimens were taken. "The leaves were taken from plants in their 7th season and consisted of the young shoots from which tea is manufactured, viz. the bud, and first, second, and third leaves, down the stem. In none of the samples were there old leaves or actual wood. A shoot with this number of leaves is usually the growth of about twelve days after the bud has got started to grow. The indigenous sample is from the variety of the plant which was originally found growing wild in the jungles of these districts. It is, I should think, the true *Thea viridis*. It is a very large growing plant, almost a tree, and its leaves when full grown are very large and succulent. It yields by far the best quality of tea. The other sample was from a hybrid plant. This is supposed to be a true hybrid between the indigenous and China varieties, and certainly partakes very much of the peculiarities of

both varieties. The China plant is the variety, which I think is the correct *Thea Bohea* originally imported direct from China. It is a miserable, small-growing, stunted plant compared to the indigenous, the full-grown leaves being only about 2 inches long, and the tea is inferior. The hybrid gives a good strong tea, and is a hardier plant than the indigenous, and so is very much liked, but the more closely it approaches to the indigenous it is the more highly prized." The specimens received by me had been mainly dried in heated rooms. The produce of the crop was estimated at 400 lbs. of dried tea per English acre.

It is so seldom that we are able to obtain any precise account of the history of the specimens of tea and other foreign productions which have been submitted to chemical examination that Mr. Davidson's report possesses especial importance.

One hundred parts of each variety of the tea gave me the following results :—

	Indigenous.	Hybrid.
Moisture	16.06	16.20
Organic matters	78.81	78.98
Mineral matters	5.13	4.82
	100.00	100.00
Nitrogen in the dried tea	4.74	2.81

The ash of each respectively, consisted of—

	Indigenous.	Hybrid.
Potash	35.200	37.010
Soda	4.328	14.435
Chlorine	3.513	2.620
Sulphuric acid	5.040	6.322
Phosphoric acid	18.030	9.180
Oxide of iron	2.493	2.463
Protoxide of manganese	1.024	0.800
Lime	8.986	5.533
Magnesia	4.396	5.910
Sand and silica	0.500	1.300
Charcoal	2.900	1.830
Carbonic acid	13.590	12.600
	100.000	100.000

I was also enabled to submit to examination specimens of the soil and subsoil from the field on which the tea had been grown. Both soils were of a reddish colour, and in fine powder. The subsoil, which was taken 1 foot 6 inches below the surface, being rather deeper in colour than the soil. A textural examination of the specimens was made according to the method which I have described in my work on "Chemistry for Farmers," and gave the following result :—

100 parts of each respectively were found to consist of—

	Soil.	Subsoil.
Sand in fine powder	71.5	82.5
Clay	28.5	17.5

Carbonate of lime, less than 5 per cent.

Both soils may therefore be described as *sandy loams.*

CHEMICAL COMPOSITION.—

100 parts of each respectively consisted of—

	Soil.	Subsoil.
Organic matters	4.75	5.18
Chloride of sodium	0.11	0.35
Potash	0.03	0.03
Oxide of iron	6.00	7.20
Oxide of manganese	trace	trace
Alumina	2.02	3.86
Lime	trace	0.10
Magnesia	0.12	0.05
Sulphuric acid	0.07	0.35
Phosphoric acid	0.05	0.03
Insoluble siliceous matters	64.80	56.50
Moisture	22.20	24.44
Nitrogen, per cent	0.158	0.22

The amount of nitrogen and alkalies in the subsoil, it will be perceived, exceeds that which was found in the

surface-soil. This, I consider may be owing to the circumstance, that heavy rains (40 inches within four months), had fallen for some time before the specimens were taken.

Another sample of Cachar tea kindly forwarded to me by Dr. Joseph Nelson, was also examined, chiefly for the purpose of ascertaining how far we could rely upon the determination of the amount of matters which are removed by heating tea with boiling water, as indicative of the presence in the tea of commerce of exhausted tea, or of foreign leaves.

100 parts of the specimen were found to contain 4·963 parts of moisture, and the ash amounted to 5 parts. By treating the leaves with boiling water until exhausted of soluble matters, and evaporating the solution to dryness, an extract weighing 42·4 grains was obtained. Determinations of the amount of nitrogen in the leaves as received, and also in the insoluble residue, were made, and while the nitrogen of the original sample amounted to 4·425 per cent, the insoluble residue was found to contain only 2·109 parts, the amount of mineral matters by treatment with water being reduced to 1·56 parts, so that 68 per cent of the total mineral matter of the tea, and about 58 per cent of the nitrogen had been removed in the infusion.

CHEMISTRY APPLIED TO THE DETECTION OF ADULTERATION.

By ALFRED H. ALLEN, F.C.S.

III.—*Mustard.*

GENUINE mustard consists of the mixed flour of black and white mustard seeds, without any addition of farina or colouring matter. The black and white mustard exhibit essential differences in their composition, as is seen in the following recent analyses by Dr. Hassall* :—

	Brown Mustard. Per cent.	White Mustard. Per cent.
Moisture	4·84	5·36
Fixed oil	35·70	35·78
Myronic acid	4·84	none
Myrosin and albumen	29·54	27·48
Sinopine hydro-sulphocyanate..	3·59	10·98
Cellulose	16·76	16·29
Ash	4·73	4·11
	100·00	100·00

The myrosin is an albumenoid body, which, in presence of water, acts on the myronic acid and converts it into allyl-sulphocyanate,† or volatile oil of mustard, to the presence of which the extreme pungency of mustard after admixture with water is due. It will be seen that myronic acid, the source of the volatile oil, is found only in brown mustard, but the real amount existing is very doubtful, Ludwig and Lange having obtained only 0·2 per cent of potassium myronate from brown mustard.

The usual additions to mustard are foreign farinas (wheat-flour is the most common) for increasing the weight and bulk, turmeric as a colorant, and cayenne for imparting a fictitious strength. Before the new Act came into operation, by far the larger quantity of the mustard sold was largely adulterated, and there are still numerous instances in which "mustard condiment" is sold without acknowledgment of its nature either by label or word of mouth. Regarded merely as a condiment, there can be no harm in selling diluted mustard provided the purchaser is informed of its true nature, but it must not be forgotten that mustard is also a drug or remedy. If a mustard plaster is applied in a case of emergency, or mustard and

water given as an emetic for accidental poisoning, and the remedy refuses to act because of its dilution by flour, most serious consequences may ensue. Mustard is a common household remedy, and its timely application, while awaiting the arrival of the medical man, is often of great importance; but it is worse than useless if mixed with large and indefinite proportions of inert bodies, and the pretended necessity for the use of these is now fully disproved by the fact that many mustard manufacturers advertise genuine unmixed mustard of various qualities and prices, from 9d. per lb., the price being dependent on the proportion of the black and white seeds present.*

The detection of wheat or other foreign farina in mustard presents no difficulty, as mustard contains no starch naturally, and therefore the production of a blue colour, on adding solution of iodine to the cold aqueous infusion of the sample, infallibly indicates adulteration. The kind of starch present is of course ascertained by the microscope, which also gives a rough idea of its relative amount, but it seems very desirable, when possible, to ascertain and certify to the percentage of adulteration, and this can be done with a fair approach to accuracy in the following manner :—

It will be seen from the above analyses by Hassall that both brown and white mustard farinas contain a large proportion of fixed oil, and the amount is practically the same in both varieties. The estimations of fixed oil were made by Hassall by exhaustion with ether, and in various commercial mixtures of the white and brown mustards he found by the same process quantities varying from 33·97 to 36·75 per cent, the average being 35·53. I have myself, by exhaustion of genuine mustards with benzol, found a mean of 35·1.†

The extent of the adulteration of any sample of mustard can therefore be very fairly ascertained by estimation of the percentage of oil. This is done by exhaustion with benzol or ether, of which I prefer the former. 2 grms. of the sample are treated in a flask with about 30 c.c. of commercial benzol, the flask attached to a reversed Liebig's condenser, and the liquid boiled gently, and filtered into a flask after cooling. The process is repeated till the mustard is thoroughly exhausted, when the benzol holding the oil in solution is distilled off, and the residue heated to 130° C. till it ceases to lose weight, when the remaining fixed oil is weighed. If the proportion of oil in genuine mustard is taken at 35 per cent, the percentage of oil in the sample, multiplied by 2·857, will be the percentage of real mustard present.

Some chemists determine the amount of admixture in mustard by estimating the sugar produced by boiling the sample with dilute acid. This method involves the assumption that the flour added is constant in composition ; and the fact that glucose is one of the products of the decomposition of myronic acid has been altogether lost sight of.

Turmeric is readily recognised under the microscope by its characteristic structure, and its yellow colour, changed to blue by iodine. It may also be detected with great readiness by the following test :—About 1 grm. of the sample is boiled with methylated spirit, and filtered. The yellow tincture is evaporated in a capsule at a steam heat, and, when concentrated, a small piece of filter-paper (the size of a penny) is immersed in the liquid, the evaporation of which is carried to dryness. The paper is then

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* "Food, Water, and Air"; February, 1874.

† The change is probably expressed by the equation—

$$K_2C_{20}H_{33}N_2S_4O_{19} = 2KHSO_3 + 2C_3H_5,CNS + 2C_6H_{12}O_6 + H_2O.$$
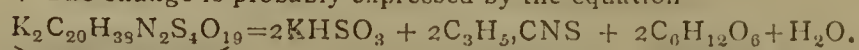
<u>Potassium myronate.</u>   <u>Allyl-sulphocyanate.</u>   <u>Glucose.</u>

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* It has always seemed to me that the argument is remarkably weak which supposes that the low price of an article gives the purchaser sufficient information of its quality, and that he must know that it could not be pure at the price. Unless he is in the habit of buying the article, or has had his attention directed to the usual price, the purchaser is often quite ignorant of it. Exclusive of public analysts, how many of the readers of the CHEMICAL NEWS know the market price of mustard, lard, coffee, cocoa, &c.?—A. H. A.

† The constancy of these results throws great doubt on the statement that one object in the addition of wheat-flour is to dry up the mustard and prevent the necessity of extracting a portion of the fixed oil. At any rate, the proportion of oil in a sample of adulterated mustard is a fair criterion of the amount of admixture, as it is just such mixed mustard which does not require the removal of any of the oil.

moistened with a saturated aqueous solution of boric acid, when, after re-evaporating, the paper will acquire a reddish colour if turmeric be present. As a further proof, caustic potassa or soda should be dropped on it, when a very beautiful series of colours will be produced, green and purple being the most prominent. On adding hydrochloric acid a red colour is produced, which is again turned green and blue on addition of excess of alkali. The colours are very vivid and characteristic, pure mustard giving no such result.*

The fluorescence of the tincture also serves for the detection of turmeric. It seems very questionable whether turmeric is ever mixed with mustard in sufficient quantity appreciably to affect the weight or bulk of the article; but its recognition is sometimes important as it is not added to genuine mustard, and therefore adulteration of some sort may be inferred from its presence.

Gamboge is said to be sometimes used for colouring mustard. It does not give the turmeric reaction, but is turned red by alkali, and restored to yellow by addition of acid. The purgative properties of gamboge render its employment as a colouring matter very undesirable.

Cayenne Pepper, or Capsicum, is often added to adulterated mustard to increase its pungency. It is recognisable by the microscope, and also very readily in the following manner:—The mustard is treated with spirit as in testing for turmeric, the tincture is evaporated, and the extract *tasted,* when the pungent biting flavour of cayenne will be readily perceived. A still more striking test is to heat the dry alcoholic extract and smell the fumes, when, if cayenne is present, an overpowering heat in the lungs, irresistibly compelling coughing, will be perceived. The fumes from pure mustard are not irritating, but ginger produces a somewhat similar effect.

"*Terra Alba,*" or *Plaster of Paris,* was at one time used to a considerable extent for adulterating mustard. Its presence would be detected on estimating the ash, which is always below 5 per cent in mustard free from mineral adulterations. *Chalk* is said to have been employed as an adulterant of mustard, and *chrome-yellow* for colouring.

"*Charlock,*" or wild mustard seeds, are sometimes used. Their employment can scarcely be called an adulteration, and their detection is extremely difficult, even with the microscope.

(To be continued.)

NOTES OF WORK

BY STUDENTS OF PRACTICAL CHEMISTRY

IN THE LABORATORY OF THE

UNIVERSITY OF VIRGINIA.

(No. III.)

Communicated by J. W. MALLET,

Professor of General and Applied Chemistry in the University.

(Continued from vol. xxviii., page 272).

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(1). *Analyses of the Ashes of Virginia Tobaccos, with Determinations of Nicotine and of Total Nitrogen.* By Mr. J. R. McD. IRBY, of New Orleans, La., and Mr. J. ALSTON CABELL, of Richmond, Va.

NOTWITHSTANDING the prominent position of Virginia in the production of tobacco,† there are hitherto, so far as I am aware, no results on record of any chemical examination of the ash of the plant as here cultivated, and, in the statements of Schlösing as to the relative amounts of nicotine contained in various kinds of tobacco, that from Virginia forms but a single head, whereas several varieties,

of quite different commercial characters and uses, are produced within the State. Hence it has seemed a matter of interest to obtain good typical specimens and submit them to careful examination, and this has been done under my direction in this Laboratory during the past winter by the two gentlemen above named.

I am indebted for the specimens employed to the kindness of Walter K. Martin, Esq., of Richmond, Va., whose information as to the crop in this State is both extensive and accurate. Of the following samples, two were of light-, one of medium brown-, and three of dark-coloured tobacco; all were in the "leaf" state, made up in the usual bundles, free from stalk, but retaining midrib.

No. 1, light yellow tobacco—"coal-cured wrappers" for cigars—cultivated in the counties of Virginia and North Carolina adjacent to Danville, Va. Average length of bundle=18 inches. Average weight of bundle=2·65 ozs. Avoir.

No. 2, light yellow—"fine smoking"—from counties of Virginia and North Caroline adjacent to Danville, Va. Average length of bundle=15½ inches. Average weight of bundle=2·50 ozs.

No. 3, medium brown colour—"sweet fillers" for cigars—from counties of Louisa, Caroline, Hanover, Goochland, and Fluvanna, Va. Average length of bundle=19 inches. Average weight of bundle=2·82 ozs.

No. 4, dark—"Austrian cigar wrappers" (also used in Italy for same purpose)—from Charlotte Co., Va. (similar tobacco produced in Halifax, Prince Edward, Nottoway, and Lunenberg Counties). Average length of bundle=21 inches. Average weight of bundle=4·00 ozs.

No. 5, dark—"English shipping"—cultivated in Amelia, Powhatan, Cumberland, and Prince Edward Counties, Va. Average length of bundle=22 inches. Average weight of bundle=4·58 ozs.

No. 6, dark—"exported to France for snuff" (tobacco of similar quality also largely shipped to Germany)—from Campbell and Bedford Counties, Va. Average length of bundle=20 inches. Average weight of bundle=5·37 ozs.

These specimens by no means cover all the commercial grades produced in Virginia, nor all the distinctive agricultural districts concerned in the production, but they represent some of the most important and characteristic varieties.

The method of analysis adopted was uniformly applied to all the samples, of which Mr. Irby examined Nos. 2, 3, and 5, and Mr. Cabell Nos. 1, 4, and 6. The air-dried tobacco, representing as fairly as possible all parts of the bundles taken, was in each case ground to powder, this well mixed, the different portions needed weighed off, and the residue kept in a well-stoppered bottle to be drawn from as required. It was very carefully burned at the lowest possible temperature in a partially-covered porcelain crucible suspended within one of sheet-iron, the latter serving the purpose of a hot-air bath, the heat being very gradually applied. The amount of crude ash so obtained, not entirely free from remains of charcoal, was found as follows:—

TABLE I.—In 100 parts air-dried tobacco.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
Crude ash ..	11·803	15·394	18·518	16·313	18·177	15·905

From one portion of this crude ash carbon dioxide was determined, and from another a solution was obtained by careful exhaustion with water and dilute hydrochloric acid to be used in the principal analysis,—the insoluble residue, consisting of extraneous siliceous matter (sand, &c.) and a little charcoal, being weighed. The results were the following:—

TABLE II.—In 100 parts crude ash.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
Pure ash (portion dissolved by HCl) ..	70·715	63·173	60·935	84·401	64·532	66·662
Insoluble residue (sand and charcoal)	5·295	14·694	16·978	7·916	8·819	8·969
Carbon dioxide	23·990	22·133	22·087	7·683	26·649	24·369
	100·000	100·000	100·000	100·000	100·000	100·000

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* I give this new modification of the boric acid reaction in full, as experience has proved it to be exceedingly delicate, and applicable to the detection of turmeric in cases where its recognition is less easy than in mustard.

† The United States Census of 1870 shows that Virginia afforded in that year 37,086,364 lbs., ranking second only to Kentucky among the States, while in 1860, the year before the civil war, Virginia was first and Kentucky second in reference to this crop.

No. 4 was probably more strongly heated after burning than the others, much CO_2 being expelled.

A separate portion of crude ash was treated with nitric acid in order to get a solution in which to determine chlorine, and independent experiments were made to prove (as they did) that no appreciable loss of chlorides had occurred by volatilisation, or of sulphates by reduction to sulphides. The general analysis, conducted by the usual methods, yielded—

TABLE III.—In 100 parts pure ash (including Fe_2O_3 and Al_2O_3).

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
SiO_2	1·388	2·202	2·509	1·073	0·846	1·932
Cl	2·242	2·696	4·263	2·358	3·679	1·109
SO_3	9·587	3·231	3·630	5·416	4·602	5·466
P_2O_5	3·512	1·235	3·372	2·219	4·408	4·379
K_2O	39·500	26·728	36·355	32·170	39·888	31·894
Na_2O	2·741	1·121	3·150	6·584	1·318	1·269
CaO	31·123	47·273	29·424	32·561	37·359	39·682
MgO	8·578	10·103	13·889	14·692	6·369	8·475
Fe_2O_3 and Al_2O_3	1·329	5·411*	3·408	2·927	1·531	5·794
	100·000	100·000	100·000	100·000	100·000	100·000

* By difference.

Assuming the alumina and most, at any rate, of the ferric oxide to have been derived from adherent soil or dust, the above analyses have been re-calculated, excluding these two constituents; hence are obtained the figures of

TABLE IV.—In 100 parts pure ash (exclusive of Fe_2O_3 and Al_2O_3).

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
SiO_2	1·407	2·328	2·597	1·105	0·859	2·004
Cl	2·273	2·850	4·413	2·428	3·737	1·174
SO_3	9·710	3·416	3·757	5·581	4·674	5·803
P_2O_5	3·560	1·306	3·490	2·286	4·478	4·658
K_2O	40·040	28·257	37·641	33·139	40·509	33·870
Na_2O	2·778	1·185	3·261	6·789	1·339	1·353
CaO	31·538	49·977	30·462	33·540	37·940	42·140
MgO	8·694	10·681	14·379	15·132	6·464	8·998
	100·000	100·000	100·000	100·000	100·000	100·000

The total nitrogen was determined for each sample by Dumas's method, and also, for comparison, by combustion with soda-lime, it being known that the latter process would yield results below the truth, but how far below it seemed well to notice. The nicotine was determined volumetrically by means of a standard solution of potassio-mercuric iodide, as recommended by Zinoffsky,* this process being carefully compared in one instance with that formerly adopted by Schlösing. Each specimen of the air-dried tobacco, as used for analysis, was also carefully dried by prolonged heating at 100° C., and the water thus determined. These results are given in

TABLE V.—In 100 parts air-dried tobacco.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
Nitrogen, by absolute method	2·931	2·587	3·290	5·190	4·620	4·748
Nitrogen, by combustion with soda-lime	1·978	1·552	1·950	4·333	3·920	4·420
Nicotine, by potassio-mercuric iodide	3·062	3·550	4·660	6·382	5·350	8·002
Nicotine, by method of Schlösing	—	3·580	—	—	—	—
Water, by drying at 100° C.	7·911	1·001	11·671	9·932	13·744	9·707

It is remarkable that so small an amount of water was driven off from No. 2 at 100° C.; this specimen, however, was obviously very dry as received, the leaves cracking and crumbling to pieces very easily on handling. If now the water thus found be deducted from the weight of air-dried tobacco, and the pure ash (deducting sand, charcoal, CO_2, Al_2O_3, and Fe_2O_3) and the nitrogen as determined by Dumas's method be alone considered, we have as the percentage of ash, nitrogen, and nicotine for the dry plant, the following :—

* *Chem. Centralblatt,* March 5, 1873, s. 153

TABLE VI.—In 100 parts tobacco dried at 100° C.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	Mean.
Total ash (pure)	8·943	9·292	12·340	14·839	13·391	11·062	11·645
Total nitrogen	3·183	2·633	3·725	5·762	5·258	5·333	4·310
Nicotine	3·325	3·586	5·276	7·086	6·202	8·862	5·723

Subtracting from the total nitrogen as thus stated the amount of this element represented by the nicotine in each case, we find the percentage of nitrogen in other forms (albumenoids and nitrates) than that of the alkaloid—

TABLE VII.—In 100 parts tobacco dried at 100° C.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	Mean.
Nitrogen in other forms than that of nicotine	2·608	2·013	2·813	4·538	4·262	3·727	3·327

The average percentage composition of the pure ash (for the six specimens), obtained by taking the mean of the figures in each line of Table IV., is as follows :—

TABLE VIII.

SiO_2	1·717
Cl	2·812
SO_3	5·490
P_2O_5	3·296
K_2O	35·576
Na_2O	2·784
CaO	37·600
MgO	10·725
	100·000

It appears from the above results that the average total amount of pure ash, referred to material dried at 100° C., is less than that recorded for European (including Turkish) tobacco, the average for ten specimens of the latter *air-dried* being 15·50 per cent, and for three specimens dried at 100° C. 16·82* per cent; and also falls below the average for the tobacco of Connecticut and Massachusetts, given at 16·56 per cent (mean of twelve specimens) by Prof. S. W. Johnson,† and at 16·32 per cent (mean of five specimens) by E. S. Breidenbaugh.‡ On the other hand, the average for thirty specimens of Kentucky tobacco‖ 12·83 per cent—agrees much more nearly with these Virginia results. If it be allowable to draw any conclusion from the averages of individual figures differing so widely among themselves, the question suggests itself whether the relatively rapid growth of the plant in the shorter season of the more northern regions of production, and perhaps less complete maturity of the tissues at cutting, may be attended with an habitually larger percentage of mineral matter.

As regards the relative proportion of the different mineral ingredients, the results agree generally with those above referred to for tobacco of other localities, especially as to the more important substances, as will be seen from Table IX., the agreement in the case of the European analyses being a good deal affected by a probable excess of silica in these (due to burning at too high a temperature), and the very abnormal figures for the alkalies in one or two of the analyses (that of the Turkish tobacco showing but a fraction of 1 per cent of K_2O, while one of tobacco from the Palatinate gives over 17 per cent of Na_2O !). There is perhaps shown a tendency to rather more lime and magnesia in the Virginia than the Kentucky samples, and in the latter as compared with those from New England. The large proportion borne by the basic to the acid constituents of the ash of course illustrates the well-known large extent to which salts of organic acids occur in tobacco.

That the results as regards mineral matter vary a good deal, even for the product of a single locality, is shown by a few experiments made with *single whole leaves* taken from the *same bundle* of Virginia tobacco,—determining

* E. Wolff, "Ashen-Analysen v. Landw. Product u. s. w.," Berlin, 1871, ss. 112-3.
† "Ann. Rep. of Conn. Board of Agric.," quoted in *Journ. Chem. Soc.*, March, 1874, p. 286.
‡ *American Chemist*, February, 1873, p. 286. (These specimens probably form a part of those referred to by Prof. Johnson).
‖ Dr. Peter (quoted by Prof. S. W. Johnson), *loc. cit.*

TABLE IX.
Average for Tobacco from

	Virginia (six specimens).	Kentucky (thirty specimens).	New England (twelve specimens).	Europe (including Turkey) (thirteen specimens).*
SiO_2 ..	1·717	2·728	0·845	10·292
Cl ..	2·812	3·741	9·360†	4·920
SO_3 ..	5·490	4·209	6·582	4·304
P_2O_5..	3·296	4·988	3·563	3·217
K_2O ..	35·576	37·568	34·964	18·008
Na_2O..	2·784	2·105	1·993	4·289
CaO ..	37·600	35·308	34·481	43·511
MgO..	10·725	9·353	8·212	11·459
	100·000	100·000	100·000	100·000

simply the total ash and one or two principal constituents. Thus—

Per cent of ash (free from CO_2, charcoal, and sand.

1 leaf (A), dried at 100° C., gave 11·790
1 „ (B), „ „ „ 12·417
1 „ (C), „ „ „ 11·875
1 „ (D), „ „ „ 11·817

and in the above amounts of ash there was found—

A .. 3·434 of CaO and 5·428 of K_2O
B .. 4·546 „ „ 4·046 „
C .. 3·619 „ „ 5·280 „
D .. 4·671 „ „ 3·758 „

Very possibly these differences may depend in part upon the different stages of maturity reached by the individual leaves before cutting.

The variation of the several ash analyses, even of the plant from neighbouring parts of the State, does not seem to leave room for tracing any connection with the geological conditions of growth. An apparent tendency to larger percentage of phosphates in the heavy, dark, shipping tobaccos as compared with those of fine light colour suitable for the better class of cigars may probably be connected with the coarse rank growth and larger proportion of nitrogenous matter which the former exhibit.

As regards the amount of nitrogen and of nicotine in the different specimens, the well-known occurrence of these constituents in larger proportion in the coarse as compared with the finer tobaccos is clearly seen. An examination of the figures in Tables VI. and VII. shows that the nitrogen of the nicotine represents a fraction of the total nitrogen present, varying in each case, but less so than might perhaps have been expected.

TABLE X.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	Mean.
Relative amounts of nitrogen occurring as nicotine, compared to total nitrogen = 100 ..	18·2	23·6	24·5	21·3	20·1	28·9	22·8

The amount of nicotine afforded by No. 6 is very large—somewhat larger than of the figures quoted from the results of Schlösing.

(To be continued).

NOTICES OF BOOKS.

Tea, Coffee, and Cocoa Analysis. By J. ALFRED WANKLYN. London : Trübner and Co.

THIS work is another of the series of manuals which are gradually rendering the analysis of food, and the detection of its adulterations, simple and certain. For the assay of teas, the author, following up the indications afforded by Peligot, depends chiefly on a determination of the amount of matter capable of extraction by boiling water. It is found that the extract, evaporated to dryness and weighed, yields results constant, and agreeing with the amount found by weighing the leaves before and after extraction. With the aid of the directions given, the entire operation may be performed within two hours. It is, however, pointed out that the extract of genuine teas may range from 32 to 50 per cent. In samples adulterated with previously extracted and re-dried leaves—a very common form of adulteration—the ash is not merely less in total quantity, but different in composition. One-half of the ash of a sample of genuine tea is soluble in water; whilst the ash of spent tea yields, according to Mr. Allen, only 0·5 per cent of soluble salts. Genuine teas rarely yield so little as 5 per cent of total ash, and rarely so much as 6 per cent. The presence of an occasional grain of sand is unavoidable in an agricultural product collected on the large scale, and, as the author justly remarks, should not be considered as an adulteration. Genuine tea is rich in nitrogen to an extent rarely met with in leaves. Hence, where the presence of spurious leaves is probable, a determination of nitrogen by combustion (Gay-Lussac's method), or a determination of " free " and "albumenoid" ammonia, as described in Mr. Wanklyn's " Water Analysis," is recommended. A normal percentage of ash, a considerable part of which is sand (or magnetic oxide of iron) is rightly pronounced strong evidence of sophistication. Where the ash, on the other hand, much exceeds 6 per cent, the author directs that a large quantity should be boiled in excess of water, and the sand, &c., estimated by subsidence, washing, and ignition. The quantitative determination of theine, he considers, will require much improvement and simplification before it can yield available data. On the vexed question of "facing," and the extent to which, if at all, it should be permitted, Mr. Wanklyn is silent.

The quantitative examination of coffee may perhaps be pronounced less difficult than that of tea. The facts upon which the analysis of coffee is based are that it contains no starch, that when roasted its percentage of sugar ranges from 0·0 to 1·14, and that its ash is free from soda. The first point enables us to distinguish a whole class of possible adulterants. Chicory, when roasted, contains 12 to 18 per cent of sugar, so that the amount of chicory present in a sample of coffee may be approximately estimated by the copper-reduction test. Thus a mixture of 3 parts coffee and 1 part of chicory would contain at least 3·85 per cent of sugar. A colorimetrical test is also recommended, the tinctorial power of chicory, even at 212°, being three times as great as that of medium roasted coffee. In solutions made at common temperatures the difference is still greater. The ash of chicory, as shown by Mr. Allen, contains a far smaller proportion of soluble salts than does that of coffee.

We agree with Mr. Wanklyn that dealers who sell coffee mixed with chicory should be compelled to declare, approximately, not merely the presence, but the proportion of the root. We differ from him, however, when he considers that the mixing of coffee with chicory is—or rather *was*—demanded by public taste. As a proof that our view is correct, we venture to prophesy that the proposal to have the proportions of the admixture stated will meet with most violent opposition, and that, if it becomes law, dealers will all at once discover that the public had better buy the two articles separately and mix for themselves. We may fairly pronounce this work to be one which no public analyst, chemist, or medical man can safely dispense with.

City of Boston : Fifteenth Annual Report of the Inspector of Milk. 1874.

THE most interesting portion of this official document is naturally the report of the analyst, Mr. J. M. Merrick. Out of thirty-six consecutive samples which he has ex-

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* Fe_2O_3 deducted from the results of analysis as given by Wolff, so as to make the figures comparable with those for the American tobaccos.

† This large amount of chlorine, with the small proportion of sodium below, is worthy of notice. Can this be due to manuring with Stassfurt salts of potash?

amined he announces one only as being free from added water. That one contained 15·7 per cent of total solids. Elsewhere he gives his opinion that "milk to be marked pure should have at least 9·3 per cent of *solids not fat.*" If to this we add an average amount of fat, we find the total solids certainly not less than stated by Müller, Eisenstuck, and Wanklyn. Hence Mr. Merrick's extensive experience furnishes additional evidence against the notion, taken up by the recent Parliamentary Committee on the Adulteration of Food, that the total solids of pure milk may fall below 10 per cent. We commend this matter to the especial attention of Mr. Sewell Read and his colleagues.

CORRESPONDENCE.

THE GLOVER TOWER.

To the Editor of the Chemical News.

SIR,—The reporter of the *Moniteur Scientifique*, in his report on the Vienna Exhibition, having stated that the cost of erection and excessive wear and tear on the Glover tower was against its use in the manufacture of sulphuric acid, will you allow me to use the following as an answer to it for the benefit of your readers?

I have at work here a tower which was erected, January, 1868, at a cost of about £450. It has been in constant use from that time till now, and has cost under £70 in repairs. During the same period, it has denitrated and concentrated upwards of 73,000 tons of acid, to a specific gravity of 1·750, entirely by the combustion of 15,400 tons of pyrites, no coal or other fuel being used. The tower is still at full work, and to all appearances will work many years.

I am aware that very much inferior results have been obtained, but the fault has always been in the construction or management of the apparatus, and is not inherent in it.—I am, &c.,

JOHN GLOVER.

Wallsend-on-Tyne, August 25, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 3, July 20, 1874.

Action of Two Elements of the Current.—J. Bertrand.—Ampère concludes that two parallel currents attract each other when their direction is the same, but repel each other when it is opposite. He generalises this rule by extending to the elements of the current, to which he applies, whatever may be their relative direction, the idea of a movement of the same, or of an opposite kind. Two currents are said to be of the same kind if they both depart from a common perpendicular, or if they mutually approach each other. In adopting this phraseology, it becomes no longer accurate to say that two currents of the same kind attract each other. It is not even exactly true in the case of parallel elements. As the assertion has been re-produced in all works on physics, and is made to serve as a basis for several important explanations, M. Bertrand shows that it is not in harmony with Ampère's law, and undertakes the solution of the following question :—An element of a current being given, to find in one point of space the direction which must be assigned to another element, in order that their mutual action may be attractive, repulsive, or neuter.

Third Note on the Electric Conductivity of Woody Bodies.—Th. du Moncel.—Hard woods part less easily than soft woods with the moisture which they have stored up, and this moisture, after the first superficial drying re-appears at the end of a certain time. On the other hand, when completely desiccated they take up moisture more slowly from the atmosphere than do soft woods. But as this absorption is continual, they become, after a long time, pervaded by a large quantity of moisture, even when kept in a dry place.

Stratifications of Electric Light.—M. Neyreneuf.—Stratifications of the electric light may be obtained under the following circumstances, which render it possible to produce with static electricity inversions of charges as rapid as those given by the use of Ruhmkorff's coil :—Suppose the two condensers of Holtz's machine connected by a Geissler tube instead of communicating by a continuous piece of sheet metal. The machine is then arranged so as to give small sparks, succeeding each other with great rapidity. Two inverse currents will then traverse the Geissler tube, showing very distinct stratification. In order to succeed, even with very long and wide tubes, it is necessary to replace the ordinary small bottles with jars of great size. Those which the author employed had 1873 square centimetres of surface.

Passivity of Iron.—A. Renard.—Iron may be rendered passive in ordinary nitric acid at from 37° to 40° B. by placing a single wire, 0·02 m. in length and 0·001 m. in thickness, in 20 to 30 c.c. of the acid at the temperature of 17°. The iron is at first briskly attacked, but the action ceases spontaneously, the sooner if the wire is moved about, and the metal then becomes passive. If 20 to 30 c.c. of ordinary acid of the same strength be kept at temperatures of from 0° to 5°, several iron wires may be rendered passive by plunging them one by one into the acid, waiting each time till the action has subsided in order to avoid too great a rise of temperature. If the whole mass of iron is plunged at once into the acid the action is too energetic. Temperature has a great influence on the above phenomenon. It is the same with nitric acid of 41° to 45° B., which does not attack iron in the cold, but begins to act if the temperature be raised to a suitable degree. The more water is contained in the acid, the lower is the temperature at which it acts. Iron may also be rendered passive in common nitric acid at from 33° to 36° B., and at temperatures from 17° to 20°, by plunging a wire, 2 centimetres long and 1 millimetre in diameter, into 20 to 30 c.c. of the acid, and pressing it strongly and repeatedly against the side of the glass. With acid of 36° B. this result is produced after two or three contacts ; with acid of 33° B. a little more time is requisite. On touching passive iron, immersed in ordinary nitric acid with a platinum wire, the passivity does not cease, as happens with a copper wire. This fact finds its explanation in the following result :—An iron wire, upon which a gold or platinum wire is coiled, is only very slightly attacked when plunged into dilute nitric acid at from 30° to 40° B., and at the temperature of 17°. The iron wire becomes subsequently passive. These experiments are analogous to those of Schœnbein, in which iron became passive when submitted to the action of an electric current, the positive electrode immersed in common nitric acid being of iron.

Action of Chloroform on Sodium-Aceto Ether.—Oppenheim and Pfaff.—Not adapted for abstraction.

Isomeric Compounds, C_2H_4IBr.—C. Friedel.—The author denies the existence of a third isomer of this formula.

Development of Heat Produced by the Contact of Sulphate of Soda with Water, at Temperatures where the Known Hydrates of Sulphate of Soda Cannot Exist, and where this Salt is only Deposited in an Anhydrous State from its Saturated Solution.—M. de Coppet.—The author's recent experiments confirm the conclusion which he formerly drew from studying the congelation of the solution of sulphate of soda (*Annales de*

Chimie et de Physique, 4 series, t. xxv., p. 542), namely, that this solution does not, as is generally thought, contain merely a single modification of sulphate of soda, or a mixture of hydrates of that salt. The relative quantities of the compounds pre-existing in the solutions must be conceived as varying in a continuous manner, as a function of the concentration and of the temperature. The author's own experiments, and those of Rudorff (*Poggendorff's Annalen*, cxlv., p. 599), lead him to think that the same holds good for the solutions of many other salts.

Ethers of Normal Propyl-Glycol.—E. Reboul.—Not adapted for abstraction.

Experiments on the Generation of Proto-Organisms in Media Protected from Atmospheric Germs.—M. Onimus.—The author concludes from his experiments that proto-organisms may be formed and developed in albumenoid liquids protected from the air.

Composition of Permanganate of Potash.—E. J. Maumené.—Phipson and Terreil have maintained that the permanganate of potash, commonly so-called, is merely a bimanganate, and that manganese forms only one acid. Maumené furnishes experimental evidence that the ordinary view is correct.

New Method of Determining Metals and Oxides.—E. J. Maumené.—The main difficulty in determining both metals in the state of oxides and the oxides themselves springs from the readiness with which oxides, when heated to redness in the air, assume varying and uncertain degrees of oxidation. Copper, for instance, if determined in the state of oxide, may be Cu_2O nearly pure if it has been ignited at a high temperature and cooled quickly, or CuO if it has been cooled slowly, and if it has preserved the state of molecular division which it had before ignition. One and the same weight of oxide may, therefore, contain either 88·89 per cent of metal or only 80 per cent, according as it is in one or the other of these extreme cases. This difficulty is sometimes got over by reducing a known weight of the oxide in a current of hydrogen—an operation not without difficulties, and involving loss of time. It is easy to avoid these difficulties. The oxide, as soon as it has been ignited until the filter is destroyed, is moistened with a slight excess of sulphuric acid, and heated with the needful precautions to bring it to the state mO,SO_3, which is very easy. In taking the exact weight of the sulphate a new difficulty appears. The sulphate in a pulverulent state eagerly attracts moisture. To overcome this drawback, it is sufficient to add to the sulphate whilst still hot a known weight of stearic acid, or of any other fatty matter fusible and not volatile between 200° and 300°.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, No. 11, 1874.

This number contains no original chemical matter.

No. 12, 1874.

Assay of Beet-Roots.—M. Corenwinder, in the *Memorial de Lille*, gives the following simple process for recognising the saccharine value of the seed capsules of the beet. All those intended for propagation are plunged into a saline solution at 3·5° (B. ?). The good ones sink, whilst the inferior kinds remain suspended.

Beet-Root and Chemical Manures.—1000 kilos. of nitrate of soda supposed to be pure contain 364·7 kilos. of soda, representing 835·28 kilos. of sulphate of soda. Hence 1000 kilos. of nitrate of soda introduces into the soil materials capable of converting 3758·75 kilos. of sugar into molasses, a fact which explains the unsatisfactory results obtained by sugar manufacturers when this salt has been used. The sulphate of ammonia has not this injurious property.

No. 13, 1874.

Putrefaction Produced on the Exclusion of Air.—M. Paul Bert.—Meat does not oxidise or putrefy in com-

pressed air, though it undergoes changes of colour, texture and flavour. Certain fermentations may be arrested by oxygen at a high pressure. Wine may be prevented from undergoing the acetous fermentation by the action of condensed air.

Electric Conductibility of Woody Substances.—M. du Moncel.

Summary of Experiments made on the Ascending Movements of the Same Liquids in Capillary Tubes and in Spongy Papers.—C. Decharme.—The relative heights, the speed, and the duration of the spontaneous ascending movements of liquids are all different in capillary tubes from what they are in strips of porous paper, the external conditions being the same in both sets of cases.

No. 14, 1874.

Dielectric Constant of Certain Gases.—L. Boltzmann.—

	$\sqrt{D_{0}.\ 760}$	10·760
Atmospheric air	1·000294	1·000294
Carbonic acid	1·000473	1·000449
Hydrogen	1·000132	1·000138
Carbonic oxide	1·000345	1·000340
Nitrous oxide	1·000497	1·000503
Olefiant gas..	1·000656	1·000678
Marsh gas	1·000472	1·000443

In the above table $\sqrt{D_0.\ 760}$ denotes the square root of the dielectric constant (that of a vacuum being taken as unity), and 10·760 the coefficient of refraction, both at 0° C., and at the atmospheric pressure of 760 m.m. The equivalence of these two quantities agrees with the theory of Maxwell. Gases do not conduct electricity in a sensible amount.

Trajectory of the Electric Spark.—A. Tœpler.—The traces left upon surfaces of glass covered with a very thin layer of lamp-black by electric sparks passing from one pointed conductor to another, show under the microscope a regular structure. Sparks from 4 to 6 centimetres long generally trace a clear furrow 3 m.m. in breadth with a dark axis, the particles of soot being either projected laterally or accumulated along the axis. On the side of the positive conductor the trace of the spark is almost always ramified in bundles, which is not the case on the side of the negative conductor.

Remedy for Hydrophobia.—J. Jitzki, of Wilna, finds that the venom of *Coluber berus* and *Vipera berus* (both names for the common viper) is a cure for, and even a prophylactic against, the poison of *rabies*.

Theoretical Applications of the Experiment of Huyghens.—D. S. Stroumbo.—This interesting optical paper would not be intelligible without the accompanying diagrams.

Journal de Physique, January, 1874.

New Method for Discussion of the Problem of Diffraction in the Case of a Cylindrical Wave.—M. Cornu.

Optical Method of M. Lissajous Applied to the Study of Sounding Tubes.—M. Bourbouze.—The author employs a small thin drum with caoutchouc membranes, its interior placed in communication with a receiver like those used by M. Marey. The indications with this apparatus are opposite to those given by a simple membrane: the excursions of the drum membranes are greatest at a node, least in a ventral segment. A little mirror is glued to one of the membranes, and is caused to reflect a ray of light, as in M. Lissajous's experiments. To obtain the acoustical figures from two rectangular vibratory movements, the author stretches membranes (with mirrors) across the ends of two organ-pipes, and a ray is made to undergo double reflection by the mirrors.

Experiments on Surfusion and Supersaturation.— M. Gernez.—This describes some good arrangements for realising the phenomena with phosphorus, nitrate of lime, and acetate of soda.

Principle of Volta.—M. Auguste Righi.—The author seeks to prove the real existence of an electromotive force of contact independently of all chemical action of the surrounding medium. He describes a new electrometer for the purpose.

Apparatus for Showing Conical Refraction.—M. Laurent.

Physico-Chemical Researches on Gases and Liquids Condensed by Porous Carbon.—M. Melsens.—A *resumé* of experiments described to the Belgian Academy.

February, 1874.

Electro-Capillary Experiments.—M. Lippmann.—See *Comptes Rendus.*

New Method for Discussion of the Problem of Diffraction in the Case of a Cylindrical Wave.—M. Cornu.—Conclusion.

Note on a Means of Amplifying Considerably the very Small Displacements of a Rigid Rod.—M. Deprez. —He connects the extremity with a piston moving in a space completely filled with liquid, and communicating with a capillary tube which opens to the air. One observes the variations in the liquid column. A displacement of the piston 1-1000 m.m. may in this way be represented by 10 m.m. The suggestion is applicable to improvement of the spherometer and like instruments.

Construction of a Scale of Electrical Resistance. —M. Crova.

Equivalent Lens of an Optic System.—M. Lisleferme.

Notice of Monography of Liquid Bubbles.—MM· Marangoni and Stefanelli.—With an atmosphere of the vapour of the sulphide of carbon the authors succeeded in obtaining two bubbles, 60 centimetres diameter, probably the largest that have ever been seen. A curious effect observed is, that a bubble does not vibrate by any sound, however violent, transmitted from without, whereas it readily vibrates when the motion comes from the interior air. The phenomena of rupture of bubbles, the deformations of connected bubbles, and various other points are treated.

March, 1874.

Some General Theorems Relative to Static Electricity.—M. Bertrand.—The theorems are already known, but new and simple demonstrations are given, connecting them by a common principle.

Use of Quincke's Interference Apparatus for Construction of an Acoustic Pyrometer.—M. Chautard.

Centre of the Corona of Aurora Borealis.—M. Lespiault.

Note on a Means of Transmitting, Simultaneously, Signals in Two Directions by Means of a Telegraphic Apparatus of Compressed Air.—M. Deprez.

Some Experiments which may be made with a Tuning-Fork.—M. Gripon.—The author discusses the movement of a cord, that of a rod, the vibration of wires in liquids, and the movement of a liquid in a vibrating tube.

Favre and Valson on Crystalline Dissociation.— Given in full elsewhere.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of sesquichloride of carbon and other chemical products. Albert Eugène Damoiseau, Paris. December 13, 1873.—No. 4103. It consists in manufacturing sesquichloride of carbon by causing a mixture, in the required proportions, of chlorine and hydrocarbon gases to pass through granulated bone-black (previously freed from calcareous matters), charcoal, pumice-stone, or other suitable porous material, contained in a platinum, porcelain, or other suitable tube heated to any suitable degree, and collecting the formed sesquichloride in any suitable receiver; my improved process consequently does entirely away with the use of solar light, and I intend applying the same to the manufacture of other chemical products besides sesquichloride of carbon in which the substitution of one or more equivalents of the hydrogen of a hydrocarbon is to take place either by chlorine, iodine, bromine, fluorine, or other similar agents.

Improvements in the extraction of sulphur from sulphur ores, and in the purification of sulphur. William Henry O'Shea, Beaufort Gardens, Middlesex. December 17, 1873.—No. 4153. According to this Provisional Specification, the sulphur ore or crude sulphur is placed in retorts heated externally by steam. To produce flowers of sulphur, melted sulphur is run in a continuous stream into a heated tube or vessel, and is evaporated as rapidly as it enters.

Improvements in the manufacture of hydrochloric acid. Alexander Robertson Arrott, chemist, Saint Helen's, Lancaster. December 18, 1873.—No. 4164. The object of this invention is the obtaining hydrochloric acid from chloride of calcium.

Improvements in the evaporation of water, such improvements being applicable to the treatment of sewage and of saline solutions. Paul Curie, Gresham House, London. December 19, 1873.—No. 4181. This invention consists in producing a mixture of air and hot gases suitable for the process of evaporation, such gases being obtained by the combustion of fuel, either under steam-boilers or in other furnaces. The gases so obtained are then driven or aspirated into a reservoir, in which they are mixed with a sufficient quantity of cold air to bring the whole down to any desired temperature. The mixture of air and hot gases is then blown through the liquid sewage or saline solution, and the evaporation of the water thereby rapidly effected.

Improvements applicable to the manufacture of aluminium. Alfred Vincent Newton, mechanical draughtsman, Chancery Lane, Middlesex. (A communication from Frederic Jacquemart, Paris). December 22, 1873.—No. 4204. The object of this invention is to facilitate the manufacture of aluminium by preparing an artificial cryolite for use in that manufacture.

An improved process for the manufacture of artificial butter, lard, or shortening, for culinary and other purposes. William Robert Lake, of the firm of Haseltine, Lake, and Co., patent agents, Southampton Buildings, London. (A communication from L. D. Roudebush, New York). December 22, 1873.—No. 4209. The said invention relates to an improved process of manufacturing a substance to be used as a substitute for ordinary butter, and other like substances for culinary and other purposes.

Improvements in the manufacture of soap, and in apparatus employed therein. Michael Henry, patent agent, Fleet Chambers, Fleet Street, London. (A communication from Jean Hector Destibeaux, Boulevard Saint Martin, Paris). December 23, 1873.—No. 4211. Stearic acid or other concrete fatty acid is melted or dissolved in oleine or other oily or fatty body under a gentle heat, and hydrated or hydrous caustic soda is added to the mixture, such caustic soda containing an anhydrous proportion by weight of the fatty body. Double-bottomed frames or sesses are described having removable bottoms. Resins may be used.

Improvements in scouring wool and in utilising the products resulting therefrom. Dr. George Lunge, South Shields, Durham. (A communication from Dr Karl Kraut, Hanover, Germany). December 23, 1873.—No. 4212. The raw wool is washed in the ordinary apparatus by means of warm water to which carbonate of potassium has been added. The washing-waters are collected in tanks, and allowed to stand until the solid impurities subside. The supernatant liquor is then evaporated to dryness, and the residue heated in the bed of a furnace until it takes fire and burns off. The result is an ash which is often mixed with carbonaceous matter containing the carbonate of potassium employed for scouring, and the potassium present in the wool employed, the latter also mainly in the state of carbonate. The ash is then lixiviated, a solution of carbonate of potassium being yielded. One portion of such carbonate of potassium is used for scouring a fresh quantity of wool, and the portion not so employed is evaporated to dryness and calcined, yielding a fine kind of potash.

Improvements in the preparation of products of aniline and matters from which aniline is, or may be, derived suitable to be used in dyeing and printing and in the preparation of colouring matters. John Casthelaz, manufacturing chemist, Crumpall Vale Chemical Works, near Manchester. December 24, 1873.—No. 4225. According to this invention aniline or nitro-benzine is treated with sulphuric acid in excess and with bichromate of potash or other oxidising agent, with or without heat. From the product a soluble colouring matter can be extracted, which imparts a brown tint to woollen or other matters, the said brown tint changing to black when the dyed matters are treated with a bath of bichromate of potash, followed by an alkaline bath. Chromic acid, ammoniacal solution of copper, salt of copper, and several other agents may be substituted for the bichromate of potash.

TO CORRESPONDENTS.

THE CHEMICAL NEWS.

VOL. XXX. No. 772.

HINTS TO STUDENTS.

IN this number we give an account of the various colleges, institutions, and private establishments where the science of chemistry is taught, and where those who wish to devote themselves to its study may find the requisite facilities and the needful guidance. It will be evident at a glance that these facilities are now far more abundant and more accessible than was the case a quarter of a century ago. But the serious question naturally arises, whether the opportunities for study and research now existing are put to the best use, and whether they are bearing the fruit that might be hoped ? True, the number of chemical students, counted up statistically, has very greatly increased. But there are students, and students. There are some who bring to their tasks devotion to science, patience, perseverance, and a disposition to be accurate in everything. There are others who may, indeed, attend the lecture-rooms and the laboratories of celebrated professors, but who do not believe in work and never earnestly seek to qualify themselves for it. The first-mentioned class we honour ; as for the latter, we deplore their very existence. If work is not to be done accurately, it had better not be done at all. If a young man is not to become a sound chemist, he had better leave the study to others. Careless work hinders the progress of science, and must be cleared away, often at great expense of time and labour, before anything satisfactory can be done. Unsound, incompetent chemists injure the confidence of the public in the resources of science and in the benefits to be drawn from its revelations, and lower, not their own professional status only, but that of their worthier contemporaries. Let us bear in mind, that to have learnt a few chemical crotchets, to have absorbed a few paradoxes, and to have committed to memory a legion of formulæ, do not make a man a chemist. Before we accord that title to any one, we must be satisfied as to his power to do actual work. He may have passed examinations innumerable ; he may be rich in the inventory of other men's treasures. We would put in his hands a loaf, and ask him to say how much alum is present in it. We would give him a sample of apatite or of cobalt ore, and bid him determine the phosphoric acid in the one, or the pure cobalt in the other. Or we would take him to the blue-vat, the lead chambers, the black-ash furnace, and, pointing out to him some of the unsettled questions which there frequently come before the observer, we would ask him to undertake its investigation. If we found him able to deal accurately with such subjects, we would bid him good speed, even though his knowledge of nomenclature and formulæ were of the slenderest, and though he might not be able to draw a single " spread eagle " or " crochet pattern " on the black-board.

Indeed, slightly modifying a familiar saying, we might declare that names and formulæ are the slaves of wise men, but the masters of fools. They are, at the best, subordinate means to an end, and to mistake them for the end itself is to radically misconceive the very nature of science. A name which the eye cannot take in a single glance, which you cannot copy without looking back two or three times to the original document, is to be condemned on the mere ground of its length, no matter what other recommendations it may possess. The nomenclature so much in fashion at the present day is about as well adapted to assist reasoning on chemical questions as would be the Roman numerals to serve in arithmetical operations.

Let it not be thought that we undervalue theory, or that we would advise the student to limit himself to the mere establishment of facts. We hold that facts only receive their full value when duly co-ordinated by sound theories. But between such theories and hypotheses, neither verified nor capable of verification, there is a heaven-wide difference. The more rapidly science is advancing, the more necessary it becomes to guard it from taking a wrong direction.

It is a fortunate circumstance that, in chemistry, the abstract and the practical lie very near together. We can scarcely solve any of the difficulties daily encountered in the chemical arts without aiding the progress of pure science. And how often researches undertaken from the love of abstract knowledge have led the enquirer to discoveries of practical value, has become almost a truism.

For all this, we cannot advise anyone to give his attention to chemistry except he feels in it an attraction independent of outward remuneration. As compared with men in other professions, the chemist, however eminent, reaps but slender rewards. At the same time, he is denied the privilege of being mistaken, which is conceded to all the rest of mankind. If, therefore, the ordinary prizes of life are the sole motive of the student, we should advise him to leave the laboratory and embark in engineering or in law. But if he feels a sincere attraction for the most fruitful and the most varied of all the sciences, let him then persevere. The time will surely come when the services of chemistry to civilisation and to industry will be better appreciated than at present, and when the claims of chemists will meet with full recognition.

SCHOOLS OF CHEMISTRY, &c.

EXAMINING BOARDS.

UNIVERSITY OF LONDON.

CANDIDATES for any Degree granted by this University are required to have passed the Matriculation Examination, to which no candidate is admitted unless he has produced a certificate showing that he has completed his sixteenth year.

The Fee for this Examination is £2.

The Examination will be held on Monday, January 11th, 1875. It is conducted by means of Printed Papers ; but the Examiners are not precluded from putting, for the purpose of ascertaining the competence of the Candidates to pass, *viva voce* questions to any Candidate in the subjects in which they are appointed to examine.

Candidates are not approved by the Examiners unless they have shown a competent knowledge in each of the following subjects, according to the details specified under the several heads :—

1. Latin.
2. Any two of the following Languages :—Greek French, and German.

3. The English Language, English History, and Modern Geography.

4. Mathematics.

5. Natural Philosophy.

6. Chemistry.

The following are the particulars of the foregoing subjects of Examination :—

LANGUAGES.*

Latin—

One Latin subject, to be selected by the Senate one year and a half previously from the works of the undermentioned authors :—†

Virgil One Book of the Georgics, and one Book of the Æneid.

Horace Two Books of the Odes.

Sallust The Conspiracy of Catiline, or the War with Jugurtha.

Cæsar Two Books of the Gallic War.

Livy One Book.

Cicero De Senectute or De Amicitiâ, with One of the following Orations—Pro Lege Maniliâ, either of the four Catilinarian Orations, Pro Archiâ, Pro M. Marcello.

Ovid One Book of the Metamorphoses, and one Book of the Epistles or Heroides.

The Paper in Latin will contain passages to be translated into English, with questions in History and Geography arising out of the subjects of the book selected. Short and easy passages will also be set for translation from other books not so selected. A separate Paper shall be set containing questions in Latin Grammar, with simple and easy sentences of English to be translated into Latin.

Greek‡—

One Greek subject, to be selected by the Senate one year and a half previously from the works of the undermentioned authors :∥—

Homer One Book.

Xenophon One Book.

The Paper in Greek will contain passages to be translated into English, with questions in Grammar, and with questions in History and Geography arising out of the subjects of the book selected. Short and easy passages will also be set for translation from other books not so selected.

French—

The Paper in French will contain passages for translation into English, and questions in Grammar, limited to the Accidence.

German—

The Paper in German will contain passages for translation into English, and questions in Grammar, limited (except when German is taken as an alternative for Greek) to the Accidence.

The English Language, English History, and Modern Geography—

Orthography. Writing from Dictation. The Grammatical Structure of the Language.

History of England to the end of the Seventeenth Century, with questions in Modern Geography.

MATHEMATICS.

Arithmetic—

The Ordinary Rules of Arithmetic.

Vulgar and Decimal Fractions.

Extraction of the Square Root.

Algebra—

Addition, Subtraction, Multiplication, and Division of Algebraical Quantities.

Proportion.

Arithmetical and Geometrical Progression.

Simple Equations.

Geometry—

The First Four Books of Euclid, or the subjects thereof.

NATURAL PHILOSOPHY.*

Mechanics—

Composition and Resolution of Statical Forces.

Simple Machines (*Mechanical Powers*)—Ratio of the Power to the Weight in each.

Centre of Gravity.

General Laws of Motion, with the chief Experiments by which they may be illustrated.

Law of the Motion of Falling Bodies.

Hydrostatics, Hydraulics, and Pneumatics—

Pressure of Liquids and Gases, its equal diffusion, and variation with the depth.

Specific Gravity, and modes of determining it.

The Barometer, the Syphon, the Common Pump and Forcing-Pump, and the Air-Pump.

Optics—

Laws of Reflection and Refraction.

Formation of Images by Mirrors and Simple Lenses.

Heat—

Its sources. Expansion. Thermometers—relations between different Scales in common use. Difference between Temperature and Quantity of heat. Specific and Latent heat. Calorimeters. Liquefaction. Ebullition. Evaporation. Conduction. Convection. Radiation.

CHEMISTRY.

Chemistry of the Non-Metallic Elements ; including their compounds as enumerated below—their chief physical and chemical characters—their preparation—and their characteristic tests.

Oxygen, Hydrogen, Carbon, Nitrogen. Chlorine, Bromine, Iodine, Fluorine. Sulphur, Phosphorus, Silicon.

Combining Proportions by weight and by volume. General nature of Acids, Bases, and Salts. Symbols and Nomenclature.

The Atmosphere—its constitution ; effects of Animal and Vegetable life upon its composition.

Combustion. Structure and properties of Flame. Nature and composition of ordinary Fuel.

Water. Chemical peculiarities of Natural waters, such as rain-water, river-water, spring-water, sea-water.

Carbonic Acid. Carbonic Oxide. Oxides and Acids of Nitrogen. Ammonia. Olefiant Gas, Marsh Gas, Sulphurous and Sulphuric Acids, Sulphuretted Hydrogen.

Hydrochloric Acid. Phosphoric Acid and Phosphuretted Hydrogen. Silica.

On Monday morning at 9 o'clock in the week next but one ensuing, the Examiners will publish a List of the Candidates who have passed, arranged in alphabetical order. And on the Monday morning next following, at 9 o'clock, the Examiners will publish a List of the Candidates who have passed, arranged in Three Divisions—i. the Honours Division in the order of proficiency ; in the First and Second Divisions in alphabetical order.

A Pass Certificate, signed by the Registrar, will be delivered to each Candidate who applies for it, after the Report of the Examiners shall have been approved by the Senate.

If in the opinion of the Examiners any Candidates in the Honours Division of not more than Twenty years of age at the commencement of the Examination shall possess sufficient merit, the first among such Candidates will receive an Exhibition of Thirty Pounds per annum for the next Two Years ; the second among such Candidates will receive an Exhibition of Twenty Pounds per annum for the next Two Years ; and the third will receive

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* At the Examination of January, 1875, Greek will be ranked as optional with French and German, so that it will be sufficient for any Candidate to pass in any one of these three Languages ; though credit will be given to Candidates in Greek in addition to French or German.

† The Latin Subjects for 1875 and 1876 are—For January, 1875 :—*Horace*, Odes, Books iii. and iv. For June, 1875 :—*Sallust*, The Conspiracy of Catiline. For January, 1876 :—*Cicero*, De Amicitia and Pro Lege Manilia. For June, 1876 :—*Horace*, Odes, Books i. and ii.

‡ Candidates may substitute German for Greek.

∥ The Greek Subjects for 1875 and 1876 are—For January, 1875 :—*Xenophon*, Hell-nics, Book vii. For June, 1875 :—*Homer*, Odyssey, Book, xvii. For January, 1876 :—*Xenophon*, Anabasis, Book vi. For June, 1876 :—*Xenophon*, Anabasis, Book ii.

* The Questions in Natural Philosophy will be of a strictly elementary character.

an Exhibition of Fifteen Pounds per annum for the next Two Years; such Exhibitions to be payable in quarterly instalments, provided that on receiving each instalment the Exhibitioner declares his intention of presenting himself either at the two Examinations for B.A., or at the two Examinations for B.Sc., or at the First LL.B. Examination, or at the Preliminary Scientific and First M.B. Examinations, within Three Academical Years* from the time of his passing the Matriculation Examination.

Under the same circumstances, the fourth among such Candidates will receive a Prize to the value of Ten Pounds in Books, Philosophical Instruments, or Money; and the fifth and sixth will each receive a Prize to the value of Five Pounds in Books, Philosophical Instruments, or Money.

Any Candidate who may obtain a place in the Honours Division at the Matriculation Examination in January is admissible to the First B.A. or to the First B.Sc. Examination in the following July. But such Candidate will not be admissible to the Second B.A. or to the Second B.Sc. Examination in the ensuing year, unless he has have attained the age of Eighteen years.

First B.Sc. Examination.

The First B.Sc. Examination commences on the third Monday in July,

No Candidate (with the exception of such as have obtained Honours at the Matriculation Examination in the preceding January) is admitted to this Examination within one academical year of the time of his passing the Matriculation Examination.

The Fee for this Examination is £5.

The Examination includes the following subjects† :—

Mathematics.

Arithmetic—
The ordinary Rules of Arithmetic.
Vulgar and Decimal Fractions.
Extraction of the Square Root.

Algebra—
Addition, Subtraction, Multiplication, and Division of Algebraical Quantities.
Algebraical Proportion and Variation.
Permutations and Combinations.
Arithmetical and Geometrical Progression.
Simple and Compound Interest; Discount and Annuities for terms of years.
Simple and Quadratic Equations.
The nature and use of Logarithms.

Geometry—
The relations of Similar Figures.
The Eleventh Book of Euclid to Prop. 21, or the subjects thereof; together with the elementary properties of the Sphere, treated geometrically.
The Mensuration of the simpler Plane and solid Figures, including the Cylinder and Cone.
The equation to the Straight Line and the equation to the Circle referred to rectangular co-ordinates.
The equations to the Conic Sections referred to rectangular co-ordinates.

Plane Trigonometry—
Plane Trigonometry as far as to enable the Candidate to solve all the cases of Plane Triangles.

The expression for the Area of a Triangle in terms of its sides.

Mechanical Philosophy.

(The subjects marked with an asterisk are to be treated independently of mathematical symbols, or only by simple geometrical methods.)

*Statics—
Elementary Statics, including the Resolution of Forces, the Mechanical Powers, and the Centre of Gravity.

*Dynamics—
Elementary Dynamics, including the Laws of Motion, and propositions required for determining the Rectilinear Motion of a Body whether free or along inclined planes.

*Hydrostatics, Hydraulics, and Pneumatics—
Elementary propositions respecting the nature, transmission, and intensity of Fluid Pressure, and the Conditions of Equilibrium of Floating Bodies.
Specific Gravity, and modes of determining it.
The Common Pump and Forcing-Pump.
The Hydrostatic Press.
The Barometer.
The Air-Pump.
The Steam-Engine.

*Optics—
Laws of Reflexion and Refraction; Reflexion at plane mirrors; Reflexion at spherical mirrors, and Refraction through lenses, the incident pencils being direct. Description of the Eye; Simple Instruments; Camera Obscura and Simple Telescope.

Natural Philosophy.

Heat—
Sources of Heat; conduction—convection.
Effects of Heat; expansion generally—of water—of gases and vapours; liquefaction; vapourisation; latent heat; expansive force of steam; dew-point; gases and vapours compared.
Specific Heat.
Thermometers; Pyrometers.
Heat in the Radiant state.

Electricity—
Sources of Electricity.
Static Electricity; dual character—insulation—induction—specific inductive capacity—equivalent antithetic states—disruptive discharge—convection; Electroscopes—Leyden Jar, &c.
Dynamic Electricity; conduction—the electric current—derived currents—induction of currents; Voltaic Pile and other voltaic arrangements.
Thermo-Electricity; Electro-Thermometer.

Magnetism—
Magnets, the Earth, &c.; Induction—communication—retention—Magnetic relations of iron, steel, &c.
Electro-Magnetism—as in the spark—in conducting media—in soft iron; Magneto-Electricity; principle of Electro-Magnetic and Magneto-Electric machines.
Terrestrial Magnetism.

Inorganic Chemistry.

Matter; simple and compound.
Elementary bodies classed. Metallic and Non-Metallic bodies.
Chemical combination and Mechanical Mixture. Solution.
Outlines of Crystallography. Isomorphism. Dimorphism. Allotropic conditions of matter. Chemical Affinity. Laws of Combination by weight and by volume, as deduced from the history of the individual elements. Equivalent Numbers. Equivalent Volumes. Symbolical Notation, including questions on the Unitary System. Formulæ. Nomenclature.
Chemical actions produced under the influence of Heat. Nature of Combustion. Structure and properties of Flame. Principles of Illumination. Chemical action of Light, Photography.
Oxygen. Ozone.
Hydrogen. Water.

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* By the term "Academical Year" is ordinarily meant the period intervening between any Examination and an Examination of a higher grade in the following year; which period may be either more or less than a Calendar year. Thus the interval between the *First* Examinations in Arts, Science, and Medicine, and the *Second* Examinations of the next year in those Faculties respectively, is about sixteen months, whilst the interval between the Second B.A. Examination and the M.A. Examination of the next year, or between the Second B.Sc. Examination and the D.Sc. Examination of the next year, is less than eight months. Nevertheless, each of these intervals is counted as an "Academical Year."

† Candidates who pass in all the subjects of the First B.Sc. Examination, and also *at the same time* in the Practical Chemistry of the Preliminary Scientific (M.B.) Examination, will be considered as having passed both the First B.Sc. Examination and the Preliminary Scientific (M.B.) Examination, without being required to pay an additional Fee.

Nitrogen. Chemical constitution of the Atmosphere. Diffusion of Gases. The Oxides of Nitrogen; Nitric Acid. Ammonia.

Chlorine, Bromine, and Iodine. Their compounds with Oxygen and Hydrogen. Theory of Bleaching.

Fluorine and Hydrofluoric Acid.

Sulphur. Sulphurous Acid. Manufacture and Chemical applications of Sulphuric Acid. Other Oxygen compounds of Sulphur. Sulphuretted Hydrogen.

Phosphorus. Oxygen and Hydrogen compounds of Phosphorus. Theory of Acids. Monobasic, Dibasic, and Tribasic Acids.

Carbon. Carbonic Oxide and Carbonic Acid. The principal Hydrogen compounds of Carbon. Manufacture of Coal Gas.

Silicon and Boron. Their compounds with the elements previously enumerated.

Metals. Characters of Metals as a Class. Metallurgical Processes. Alloys. Classification of the Metals

Potassium. Nitre. Gunpowder. Theory of the action of Gunpowder.

Sodium. Manufacture of Carbonate of Soda.

Barium. Strontium. Calcium. Mortars, Cements.

Magnesium. Aluminium. Glass. Porcelain.

Manganese. Iron. Composition and properties of Cast-Iron, Wrought-Iron, and Steel. Chromium.

Cobalt. Nickel. Zinc. Cadmium.

Lead. Manufacture of White-Lead.

Copper. Mercury. Bismuth. Tin. Arsenic. Antimony.

Silver. Gold. Platinum.

Principal compounds of the Metals with the Non-Metallic elements. Theory of Salts.

Principles of Mineral Analysis.

Principles of Electro-Chemistry.

PRELIMINARY SCIENTIFIC (M.B.) EXAMINATION.*

The Preliminary Scientific Examination commences on the third Monday in July in each year.

No Candidate is admitted to this Examination until he has completed his seventeenth year, and has either passed the Matriculation Examination or taken a Degree in Arts in one of the Universities of Sydney, Melbourne, Calcutta, or Madras.

The Fee for this Examination is £5.

Candidates are examined in the following subjects of the First B.Sc. Examination† :—

> *Mechanical and Natural Philosophy.*
> *Inorganic Chemistry.*
> *Botany and Vegetable Physiology.*
> *Zoology.*

Candidates are not approved by the Examiners unless they have shown a competent knowledge in all the foregoing subjects of examination, and also in Practical Chemistry.

EXAMINATION FOR HONOURS.

Any Candidate who has passed the First B.Sc. Examination in all its subjects may be examined at the Honours Examination next following the First B.Sc. Examination at which he has passed for Honours in (1) Mathematics and Mechanical Philosophy, (2) Experimental Physics, (3) Chemistry, (4) Botany, and (5) Zoology; unless he has previously obtained the Exhibition in Mathematics and Mechanical Philosophy at the First B.A. Examination, in which case he will not be admissible to the

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* Candidates who matriculated previously to January, 1861, will not be required to pass the Preliminary Scientific (M.B.) Examination in any other subjects than Chemistry and Botany; and they will be allowed to pass the Preliminary Scientific Examination and the First M.B. Examination in the same year, if they so prefer.

† Candidates who pass in all the subjects of the Preliminary Scientific (M.B.) Examination, and also *at the same time* in the Mathematics of the First B.Sc. Examination, will be considered as having passed both the Preliminary Scientific Examination, and also the First B.Sc. Examination, without being required to pay an additional Fee; and Candidates who pass in all the subjects of the Preliminary Scientific (M.B.) Examination, and who have *previously* passed the First B.A. Examination, will be admissible to the Second B.Sc. Examination.

Examination for Honours in that subject; or unless he has previously obtained the Exhibition at the Preliminary Scientific (M.B.) Examination in either of the subjects which are common to it with the First B.Sc. Examination in which case he will not be admissible to the Examination for Honours in that subject. And any Candidate who has passed the Preliminary Scientific (M.B.) Examination in all its subjects may be examined at the Honours Examination next following the Preliminary Scientific (M.B.) Examination at which he has passed, in (1) Experimental Physics, (2) Chemistry, (3) Botany, and (4) Zoology; unless he has previously obtained an Exhibition in either of these subjects at the First B.Sc. Examination, in which case he will not be admissible to the Examination for Honours in that subject.

Candidates for Honours in Experimental Physics are examined in any of the following subjects, at the option of the Examiners :—

Statics.
Dynamics.
Hydrostatics, Hydraulics, and Pneumatics.
Optics.
Heat.
Electricity.
Magnetism.

Candidates for Honours in Chemistry are examined in any of the following subjects, at the option of the Examiners :—

Elementary Substances and their Combinations.
Electro-Chemistry.
Radiant Chemical Action.

In the Examination for Honours, the Candidate, not being more than twenty-two years of age at the commencement of the Pass Examination, who most distinguishes himself in Chemistry or Experimental Physics will receive an Exhibition of £40 per annum for the next two years.

SECOND B.Sc. EXAMINATION.

The Second B.Sc. Examination commences on the fourth Monday in October.

Candidates for this Examination who have not previously taken the Degree of B.A. are required either to have passed the First B.Sc. Examination at least one academical year previously, or to have passed the First M.B. Examination, in this University.

The Fee for this Examination is £5.

The Examination includes the following subjects :—

MECHANICAL AND NATURAL PHILOSOPHY.

(The following subjects are to be treated Experimentally, and also Mathematically so far as the subjects of the First B.Sc. Examination are applicable to them.)

Statics—

Elementary Statics, including the Resolution of Forces, the Mechanical Powers, the Centre of Gravity, and simple cases of Equilibrium of bodies or systems of bodies under the action of Gravity.

Dynamics—

Elementary Dynamics, including the Laws of Motion, and Propositions required for determining the Rectilinear Motion of a body, whether free or along inclined planes.

Direct Impact of Spheres.

Motion of Projectiles, and the simpler cases of motion round Centres of Force.

Elementary Propositions relating to Mechanical Work.

Hydrostatics, Hydraulics, and Pneumatics—

Elementary Propositions respecting the nature, transmission, and intensity of Fluid Pressure, and the Conditions of Equilibrium of Floating Bodies.

Nature and simple properties of Elastic Fluids, and the Pressures produced by them.

Specific Gravity, and modes of determining it.

The Common Pump and Forcing-Pump.

The Hydrostatic Press.

The Barometer.

The Air-Pump.

The Steam-Engine.

Optics (Geometrical)—

Laws of Reflection and Refraction; Reflection at plane mirrors; Reflection at spherical mirrors, and Refraction through lenses, the incident pencils being direct.

Separation of Solar Light into rays of different colours; description of the Solar Spectrum; description of the Eye; Simple Optical Instruments; Camera Obscura; Reflecting and Refracting Telescopes.

Acoustics—

Nature of Sounds; mode of Propagation; Musical Tones, and simple propositions respecting them.

Optics (Physical)—

Fundamental Hypotheses of the Undulatory Theory respecting the Origin and Propagation of Light.

General explanation of Interferences; formation of Newton's Rings, with descriptions of simple experiments which elucidate the effects of Interference.

Polarised Light, with the description of simple experimental modes of producing it.

Astronomy—

Systems of Great Circles to which the positions of the Heavenly Bodies are referred.

Principal phenomena depending on the Motion of the Earth round the Sun, and its Rotatory Motion round its own Axis.

General description of the Solar System.

General explanation of Solar and Lunar Eclipses.

ORGANIC CHEMISTRY.

Ultimate Analysis of Organic Bodies. Calculation of Empirical Formulæ. Methods of controlling Empirical Formulæ. Determination of the Equivalents of Organic Acids and Bases; examination of Products of Decomposition; determination of the Vapour Density of Volatile Bodies.

Law of Substitution. Compound Radicals. Homologous Series.

The Chemical History of the Cyanogen Group. Cyanogen. Hydrocyanic Acid. Cyanic Acid and Urea. Fulminates. Cyanuric Acid. Sulphocyanic Acid. Chlorides of Cyanogen. Uric Acid.

Amylaceous and Saccharine substances. Fermentation. Alcohol, Wine, Beer, Bread, &c.

Homologues of Alcohol. Ethers, simple and mixed. Oxidation of Alcohol. Aldehyd and Acetic Acid and their homologues. Anhydrides, simple and mixed. Compound Ethers.

Diatomic Alcohols and their Acids. Glycol and Oxalic Acid and their homologues.

Triatomic Alcohols. Glycerin. Fatty and Oily Bodies. Saponification.

Vegetable Acids—the principal.

Ammonia and its derivatives. Ammonium and Ammoniacal Salts. Amides and Amines: their Classification. The chief natural Organic Bases.

Colouring Matters. Indigo and its derivatives. Principles of Dyeing.

The chief constituents of the Vegetable organism. Cellulose. Vegetable Fibrin. Albumen, Casein, Gluten, &c.

The chief constituents of the Animal organism. Animal Fibrin, Albumen, Casein, Gelatin. Blood, Milk, Bile, Urine, &c.

Decay, Putrefaction. Destructive Distillation.

The Chemical principles of the process of Nutrition and of Respiration in Plants and Animals.

ANIMAL PHYSIOLOGY.

The Mechanical, Chemical, and Vital properties of the several elementary Tissues of Animals.

Nature and Composition of the principal substances used as Food by Animals.

Comparative Structure and Actions of the Organs of Digestion, Absorption, and Assimilation.

Composition and properties of the Chyle, Lymph, and Blood.

Comparative Structure, Arrangement, and Actions of the Circulatory and Respiratory Organs in the Animal series.

Chemical effects of Respiration.

Essential Structure of Secretory Organs; principal varieties presented in the structure of the Liver and the Kidney.

Objects of the several Excretory processes.

Development of Heat, Light, and Electricity by Animals.

Comparative Structure and Actions of the Nervous System.

Comparative Structure and Actions of the Organs of Sense.

Animal Mechanics.

General History of Development and Metamorphosis in the principal types of Animals.

Candidates will not be approved by the Examiners unless they have shown a competent knowledge in—

1. Mechanical and Natural Philosophy.
2. Chemistry.
3. Animal Physiology.
4. Geology and Palæontology.
5. Logic and Moral Philosophy.

A Certificate, under the Seal of the University and signed by the Chancellor, will be delivered at the Public Presentation for Degrees to each Candidate who has passed.

EXAMINATION FOR HONOURS.

Any Candidate who has passed the Second B.Sc. Examination, and has not previously passed the Second B.A. Examination, may be examined at the Honours Examination next following the Second B.Sc. Examination at which he has passed, for Honours in (1) Mathematics and Natural Philosophy, (2) Logic and Moral Philosophy, (3) Chemistry, (4) Zoology, and (5) Geology and Palæontology. And any Bachelor of Arts who has passed the Second B.Sc. Examination in Chemistry and in Geology and Palæontology may be examined for Honours in one or more of the above-mentioned subjects, provided he has gone through the Pass Examination in the corresponding subject or subjects immediately before; unless he had previously obtained a Scholarship at the Second B.A. Examination in either of the subjects which are common to it with the Second B.Sc. Examination, in which case he is not admissible to the Examination for honours in that subject.

Candidates for Honours in Mathematics and Natural Philosophy will be examined in the Honours-subjects of the First B.Sc. Examination, carried to a higher development, and also in the following:—

Higher Co-ordinate Geometry of Two, and of Three, Dimensions.

Differential Equations.

Calculus of Variations.

Dynamics of Rigid Bodies.

Hydrostatics and Hydrodynamics.

Optics.

Plane Astronomy.

The Candidate, being not more than twenty-three years of age, who most distinguishes himself in Chemistry, will receive £50 per annum for the next two years, with the style of University Scholar.

DOCTOR OF SCIENCE.

The examination for the Degree of Doctor of Science takes place annually within the first twenty-one days of June, and the Examination in each branch occupies four days.

No Candidate is admitted to this Examination until after the expiration of Two Academical Years from the time of his obtaining the Degree of B.Sc. in this University.

Candidates for the Degree of D.Sc. in any year must give notice of their intention to the Registrar, and pay to him a Fee of Ten Pounds on or before the 1st of April. If a Candidate fail to pass the Examination, the Fee is

not returned to him ; but he is admissible to any *one* subsequent D.Sc. Examination without the payment of any additional Fee, provided that he give notice to the Registrar on or before the 1st of May.

For the Degree of D.Sc., Chemical Candidates can be examined either in Inorganic or Organic Chemistry, but no Candidate will be approved by the Examiners unless he has shown a thorough practical knowledge of the Principal Subject, and a general acquaintance with the Subsidiary Subject or Subjects.

Inorganic Chemistry.

Principal Subject—Inorganic Chemistry.

Subsidiary Subjects—Either Organic Chemistry ; or Mineralogy, Crystallography, and Chemical Technology in its relations to Inorganic Chemistry.

Organic Chemistry.

Principal Subject—Organic Chemistry.

Subsidiary Subjects—Either Inorganic Chemistry ; or Chemical Technology in its relations to Organic Chemistry, and the Chemistry of Animal and Vegetable Life.

CHEMICAL LECTURES AND LABORATORY INSTRUCTION.

UNIVERSITY COLLEGE.

The Session begins on Thursday, the 1st of October, and ends about the end of June.

Chemistry.—Professor Williamson, Ph.D., F.R.S.

Assistant Professor.—Charles Graham, D.Sc.

GENERAL COURSE.

Lectures daily, except Saturday, from 11 to 12 a.m.

Exercises on Tuesdays, Wednesdays, Thursdays, and Fridays, from 9 to 10 a.m.

Fee for the Whole Course of Lectures, £7 7s. ; Perpetual, £9 9s. ; for the Organic Course alone, £2 2s.

Fee for the Exercise-Class—For the Course, £2 2s.

The Instruction in this Class is of two kinds, consisting partly of Experimental Lectures by the Professor, partly of exercises and personal instruction on the subject of the Lectures by the Assistant Professor.

A weekly *viva voce* examination is held during the First Half Course and the commencement of the Second Half Course.

Organic Chemistry.

This commences in the second week in February, and occupies Five Lectures weekly till about the end of March. It includes a study of the characteristics and metamorphoses of the chief organic acids, bases, alcohols, ethers, colouring matters, &c. Methods of ultimate and proximate analysis. Determination of molecular weights. Theory of types ; of compound radicals. Phenomena of fermentation, &c.

Practical Chemistry.

Professor Williamson, Ph.D., F.R.S.

I. *Elementary Course.*

About Forty Lessons, commencing in the first week of May. Students are taught the construction and use of apparatus for the preparation of the most important gases, acids, &c. The characteristic tests for the presence of the common acids and bases, including the chief metallic and other poisons. Also the processes for separating these bodies from one another.

Solutions are frequently given in the class for investigation.

The first six weeks of the Course are occupied by the study of the chief non-metallic elements, and their simple compounds. Metallic salts, &c., are subsequently studied.

Fee, including the cost of materials and apparatus, for the Course, £4 4s. ; Perpetual, £7 7s.

II. *Senior Course.*

This Course consists of Twenty Lessons, commencing in the first week in May.

The First Half of the Course includes tests for fixed and volatile organic acids, nitrogenised acids, sugars, glycerin, alkaloids, &c.

The Second Half of the Course includes tests for mineral poisons in organic mixtures : also tests for organic bodies, such as the alkaloids, when mixed with other organic substances.

Volumetric methods of the quantitative analysis of sugar and urea, chlorides, phosphates, hardness of water, alkalimetry, are practised.

Analyses of milk and of ashes of blood.

Fee, including cost of materials and apparatus, for the Course, £4 4s. ; Perpetual, £7 7s.

III. *Summer Matriculation Course.*

Professor Williamson, Ph.D., F.R.S., and Charles Graham, D.Sc.

This Course includes those parts of Chemistry which are required for the Matriculation Examination of the University of London.

The Course consists of about Twenty Lessons in Practical Chemistry, and of an equal number of Oral Lessons. The Practical Lessons include the preparation of the common gases and acids, &c., and the study of their characteristic properties in relation to the elementary laws of combination.

The other Lessons are chiefly devoted to those parts of the subject which require fuller oral explanation than is given in the Practical Lessons. They include numerous exercises and questions, to which answers in writing are given by the Students. These Lessons will begin on Tuesday, April 13, 1875.

Fee, including cost of materials and apparatus, £4 4s.

SCIENCE AND ART DEPARTMENT OF THE COMMITTEE OF COUNCIL ON EDUCATION, SOUTH KENSINGTON,
AND
ROYAL SCHOOL OF MINES, JERMYN STREET.

The following Courses of Lectures, Demonstrations, and Practical Laboratory instruction are now given at the New Buildings, South Kensington :—

Chemistry, by Professor Frankland, D.C.L., F.R.S. A Course of Forty Lectures on Mineral Chemistry, commencing October 5, 1874. A Course of Thirty Lectures on Organic Chemistry, commencing January 29, 1875. Laboratory instruction, consisting of an elementary and an advanced course, commencing on October 1. Fees— Lectures on Mineral Chemistry, £4 ; Lectures on Organic Chemistry, £3 ; together £6. Laboratory instruction— £12 for three months, £9 for two months, and £5 for one month.

Biology, by Professor Huxley, LL.D., F.R.S., A Course of Eighty Lectures on Biology (or Natural History, including Palæontology), with Laboratory instruction, commencing October 5, 1874. Fee for the full Course, £10— for the Lectures only, £4 ; for the Laboratory instruction, £6.

Physics, by Professor Frederick Guthrie. The Course will consist of about Sixty Lectures, with Laboratory work on the subject of the Lectures. The Course will commence on October 5, 1874. Fee for Lectures and Laboratory work, £10.

Besides the Students entering for the Associateship of the Royal School of Mines, and Teachers in Training, only such a limited number of occasional public Students will be admitted as can be accomodated. Letters with respect to the foregoing Courses should be addressed to the Secretary, Science and Art Department, South Kensington, London, S.W.

The instruction in Chemical Science embraces—

(1). A Course of Lectures on Experimental Chemistry, with special reference to the applications of Chemistry in the Arts and Manufactures.

(2). A systematic Laboratory Course for the Practice of Chemical Analysis.

(3). An advanced Laboratory Course for technical applications of Chemical Analysis and for Chemical Research.

Chemical Laboratories.—The Laboratories for instruction in chemical manipulation, in qualitative and quantitative analysis, the technical application of analysis, and in the method of performing chemical researches, are under the direction of Dr. Frankland, and will be opened on Thursday, October 1, 1874. The Laboratories at South Kensington Museum are now used for the instruction of the Pupils of the Royal School of Mines.

The charge for instruction in the Chemical Laboratory is £12 for three months, £9 for two months, and £5 for one month. This charge does not include the fees for attending the Lectures.

Professor of Metallurgy.—Dr. Percy, F.R.S.

The course of instruction in Metallurgy consists of Lectures and Laboratory Practice, especially in Assaying.

The object of the Lectures is the communication of such instruction as the Student may be able to apply to the greatest practical advantage when he may be subsequently engaged in conducting any metallurgical process.

Metallurgical Laboratory.—This Laboratory is conducted by Mr. R. Smith, under the direction of Dr. Percy, and is devoted to practical instruction in Metallurgy, especially in Assaying. The nature of this instruction will be adapted to the special requirements of the Student. It comprises :—Assaying in all its branches, especially of the more important metals, such as iron, copper, lead, tin, alloys of silver and gold, &c. ; and the examination of ores and metallurgical products.

The ability of the Student to make trustworthy assays is in every case thoroughly tested ; and no certificate of competency is given to a Student who has not furnished satisfactory proof that he is able to obtain accurate results.

The charge for instruction in the Metallurgical Laboratory is £15 for three months, £12 for two months, and £7 for one month.

Lectures to Working Men.—Short Courses of Lectures at suitable periods of the year are given in the evening to Working Men. These courses are systematic, and arranged so as to illustrate, within a period of two years, the principal subjects taught at the Institution. Those for the ensuing Session include Chemistry, Geology, Mineralogy, and Applied Mechanics.

EXAMINATIONS IN CONNECTION WITH THE DEPARTMENT OF SCIENCE AND ART, SOUTH KENSINGTON.

A sum of money is voted annually by Parliament for scientific instruction in the United Kingdom. The object of the grant being to promote instruction in Science, especially among the industrial classes, by affording a limited and partial aid or stimulus towards the founding and maintenance of Science schools and classes.

The following are among the Sciences towards instruction in which aid is given :—Acoustics, Light, Heat, Magnetism and Electricity, Inorganic Chemistry, Organic Chemistry, Geology, Mineralogy, Mining, Metallurgy.

The assistance granted by the Science and Art Department is in the form of—1. Public Examinations, in which Queen's Medals and Queen's Prizes are awarded, held at all places on complying with certain conditions. 2. Payments on results to teachers. 3. Scholarships and Exhibitions. 4. Building Grants. 5. Grants towards the purchase of apparatus, &c.

KING'S COLLEGE.

Professor of Chemistry and Practical Chemistry.—C. L. Bloxam, F.C.S.

Demonstrators.—W. N. Hartley, F.C.S., and J. M. Thomson, F.C.S.

The Session commences on the 1st of October.

I. For Students intending to devote themselves to Medicine, Pharmacy, or Scientific Chemistry, or to take a degree in Medicine or Science in the University of London. A Course of between sixty and seventy Lectures, by the Professor, commencing in October and terminating in March. Inorganic Chemistry, October till January. Organic Chemistry, February and March. On Monday, Wednesday, and Thursday, from 10.15 till 11.15. Fee, £8 8s. for the Course, or £11 11s. perpetual attendance.

II. For Students intending to devote themselves to Engineering, Manufacturing Chemistry, Mining, Scientific Chemistry, Commerce, Agriculture, Manufactures, Military Science, the Civil Service, and for those who are studying Chemistry for the sake of general information and as part of a liberal education. A Course of between fifty and sixty Lectures, by the Professor, carried on during the whole academical year. This Course is of such a character that Students may enter, without serious disadvantage, at the commencement of either of the College Terms, though it is strongly recommended that the Course be taken up in the Michaelmas Term. On Tuesday and Friday, from 10.20 till 11.20. Fee, £3 3s. a term. or £8 8s. for the year.

III. For Students who have any examination in prospect, or who require general guidance in the Chemical studies. A Course of ten or twelve Lectures in each College Term, by the Assistant Demonstrator. On Saturday, from 11.15 till 12.15. Fee, £1 1s. for each term.

EVENING CLASSES.

For Students who are preparing for any Examination, or who require a general knowledge of Chemistry applicable to any pursuit.

A. A Course of about forty Lectures, by the Demonstrator, commencing in October and terminating in March. On Monday and Thursday evenings, from 7 till 8. Fee, £1 11s. 6d. for the Course.

B. A Summer Course of about ten Lectures, in April, May, and June. On Monday evening, from 6.30 till 7.30. Fee, £1 1s. for the Course.

PRACTICAL CHEMISTRY.

For the study of Chemical Analysis of Inorganic and Organic Substances, as far as it is required in most Examinations. This Course is also preliminary to the study of Practical Chemistry in general.

Each Student works independently in the Laboratory, which is open in October, November, December, January, February, March—On Tuesday evening, from 7 till 9 p.m. Fee, £2 2s. for the Course.

May, June, July—On Monday, Tuesday, Wednesday, and Thursday, from 10.15 to 12.15 a.m. Fee, £5 5s. for the Course.

Each College Term—On Tuesday and Friday, from 10.20 till 11.40. Fee, £4 4s. per Term.

LABORATORY OF ANALYTICAL AND EXPERIMENTAL CHEMISTRY.

For the study of all branches of Practical Chemistry.

Open during all College Terms, on every day (except Saturday) from 10 till 4, and on Saturday, from 10 till 1. Fees, Experimental and Analytical Chemistry—One month, £4 4s. ; three months, £10 10s. ; six months, £18 18s. ; nine months, £26 5s.

THE SCHOOL OF PHARMACY,
17, BLOOMSBURY SQUARE, W.C.

(IN CONNECTION WITH THE PHARMACEUTICAL SOCIETY.)

The Session commences on October 1st, and extends to the end of July.

Lectures on Chemistry and Pharmacy, by Dr. Redwood.

Lectures on Botany and Materia Medica, by Professor Bentley.

Practical Chemistry.—The suite of Laboratories for Practical Instruction in General and Pharmaceutical Chemistry will be opened on October 1st, under the direction of Professor Attfield, Ph.D.

Students can enter at any period during the Session.

Two Scholarships (the Jacob Bell Memorial Scholarship), of £30 a year each, are open to competition annually in July.

Students have free admission to the Library and Museum.

CITY OF LONDON COLLEGE, LEADENHALL STREET, E.C.

The Annual Courses consist of three terms, each averaging ten Experimental Lectures. Fee, 5s. per term.

Subjects :—Junior Class, Chemistry—First year, Non-Metals ; second year, Metals and (time permitting) Elements of Organic Chemistry. Senior Class, 7 to 8 p.m., Practical Analysis.

BIRKBECK LITERARY AND SCIENTIFIC INSTITUTION.
EVENING CLASSES.

Lecturer on Chemistry.—Mr. G. Chaloner, F.C.S. Tuesdays, 8 to 9, commencing October 6.

Manipulation and Analysis.—Saturdays, 7 to 10 p.m. Under Mr. Chaloner's direction.

ROYAL POLYTECHNIC INSTITUTION,
309, REGENT STREET, W.

The Chemical and Experimental Laboratories are under the direction of Professor Edward V. Gardner, F.A.S., M.S.A., assisted by an efficient staff of Masters and Assistants.

The classes on Heat, Chemistry, Galvanism, Magnetism, and Electricity will commence in October ; they are adapted to the wants of gentlemen preparing for Matriculation, Woolwich, Sandhurst, or Direct Commissions.

The Laboratory is excellently fitted, and gentlemen can pursue their studies privately under the supervision of Professor Gardner. The Laboratory is open from 10 to 5 daily, and each evening from 7 to 10.

The Fees are arranged according to the time occupied.

Private Rooms.—A new feature in the arrangements for scientific study at the Polytechnic is the setting apart of rooms especially fitted for the pursuit of experiments and investigations of a private nature. These can be secured, with or without professional assistance, by those who need such advantages.

ROYAL VETERINARY COLLEGE, CAMDEN TOWN.

Chemical Professor.—Mr. R. V. Tuson.

BERNERS COLLEGE OF CHEMISTRY AND THE EXPERIMENTAL SCIENCES,
44, BERNERS STREET, W.

Conducted by Professor E. V. Gardner, F.A.S., M.S.A., assisted by efficient Masters.

The Laboratory is open morning and evening throughout the year, and is fitted for the convenience of private students, whose studies are under the immediate charge of Professor Gardner and his Assistants.

The subjects of Geology, Botany, and Mineralogy are in the hands of competent teachers, whose arrangements depend upon the number of members joining the class or classes.

Courses of Lectures on Electricity, Galvanism, Magnetism, &c., embracing the department of " Experimental Science " required by the Government Council of Education, are regularly established, and can be joined at any time.

The classes on the Science and Practice of Steam, and of Photography, are formed three times a year. Times of meeting, by mutual arrangement of the students and the Professor.

A Course of Lectures on Heat and Chemistry, commencing in October. Fee, £4 4s. The same course can be pursued in private study, commencing at other periods if preferred. It embraces all that is required by the Government and London University Matriculation Examinations.

Tutorial Department.—Provision has now been made by which gentlemen can be conducted through the different branches of study—Classics, Mathematics, English, Greek, Latin, French, German, Drawing (Mechanical, Free-Hand, and Object), Mechanics, Chemistry, and the Natural and Experimental Sciences—in the class-rooms at Berners College.

NORTH LONDON SCHOOL OF CHEMISTRY AND PHARMACY,
54, KENTISH TOWN ROAD, N.W.

Conducted by Mr. J. C. Braithwaite.

The Session 1874-75 commences on the 1st of October when the Laboratory will be open for Instruction in Practical Chemistry.

The classes for Chemistry, Materia Medica, Botany, and Latin meet at 8 p.m. Fee to either class, 10s. 6d. per month.

The Botanical Garden affords facilities to students desirous of acquiring a practical knowledge of Botany. During the season, Botanical Excursions are made every Saturday at 10 a.m.

As each pupil works independently, he can enter at any period to either Classes or Laboratory.

SOUTH LONDON SCHOOL OF CHEMISTRY,
325, KENNINGTON ROAD.

The subjects taught include Chemistry, Botany, Physics, Latin, Materia Medica, and Pharmacy. All apparatus and chemicals are provided for the students. There is also a special department for Instruction in Food Analysis at the Central Public Laboratory, Kennington Cross, under the personal supervision of the Director, who has been appointed Public Analyst. The Chemical portion of the Course consists of Ten Months' Lectures' on Inorganic and Organic Chemistry. The Lecturer is Dr. John Muter, F.C.S., and the hour is 10 a.m. daily. The Laboratory is open daily for Practical Instruction from 10 till 4. Secretary, Mr. W. Baxter.

The Session commences on September 15th.

ST. MARGARET'S TECHNICAL DAY SCHOOL FOR BOYS,
NEAR ARTILLERY ROW, VICTORIA STREET, WESTMINSTER.

Head Master.—Mr. Robert E. H. Goffin.

The object of the School is to supply a sound, practical Education, with especial regard to technical training, for boys from the age of seven years and upwards.

The School will be open to all boys on payment, in advance, of an entrance fee of 2s. 6d., and a tuition fee of 10s. per quarter.

Numerous Exhibitions are reserved for boys who have been for three years at least at any Public Elementary School or Schools in the Parishes of St. Margaret and St. John, Westminster, or the Parish of St. Luke, Chelsea, and have passed the Government Inspector's Examination in the standard suitable to their age and standing.

The Course of Education includes Mathematics ; Theoretical and Applied Mechanics ; Acoustics, Light, and Heat ; Inorganic Chemistry ; Electricity and Magnetism ; Practical Solid Geometry ; Physical Geography ; Animal Physiology ; Steam and Steam Engines.

LECTURES AT LONDON MEDICAL SCHOOLS.

ST. BARTHOLOMEW'S HOSPITAL & MEDICAL COLLEGE.
WINTER SESSION.

Lecturer.—Dr. W. J. Russell, F.R.S. Monday, Wednesday, and Friday, at 10 a.m. One course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. W. J. Russell, F.R.S. Monday, Tuesday, and Friday, from 11 to 1. One course, £2 2s.

CHARING CROSS HOSPITAL AND COLLEGE.
WINTER SESSION.

Lecturer.—Mr. C. W. Heaton, F.C.S. *Demonstrator.*—T. Bolas, F.C.S. Monday, Thursday, and Friday, at 11. One session, £5 5s.

The Laboratory is open daily.

SUMMER SESSION.
Practical Chemistry.—Mr. Heaton, F.C.S. *Demonstrator.*—T. Bolas, F.C.S. Monday and Friday. One session, £2 2s.
Special Evening Classes. Advanced Chemistry, Tuesday and Thursday, at 7 p.m. Fee, £2 2s. per month.

ST. GEORGE'S HOSPITAL.
WINTER SESSION.
Lecturer.—Dr. H. M. Noad, F.R.S. Tuesday, Thursday, and Saturday, at 11.30. One cousre, £6 6s.
SUMMER SESSION.
Practical Chemistry.—Dr. Noad, F.R.S. Monday, Wednesday, Thursday, and Friday, at 10. One course, including the use of apparatus and materials, £4 4s.
Physiological Chemistry.—Demonstrator—Mr. S. W. Moore.

GUY'S HOSPITAL.
WINTER SESSION.
Lecturers.—Dr. Debus, F.R.S., and Dr. Stevenson. Tuesday, Thursday, and Saturday, at 11. One course, £4 4s.
SUMMER SESSION.
Practical Chemistry.—Dr. Debus, F.R.S. Monday, Wednesday, and Friday, from 10 to 1. One course, £4 4s.
Practical Instruction is also given in the Laboratory by Drs. Debus and Stevenson during the Winter Session.

LONDON HOSPITAL.
Lectures on Chemistry.—Henry Letheby, M.B., and C. Meymott Tidy, M.B. Monday, Wednesday, and Friday, at 10.30 a.m. One session, £7 7s.
Practical Chemistry.—Dr. Letheby, M.B. Monday, Thursday, and Saturday, at 9 a.m. One session, £3 3s.

ST. MARY'S HOSPITAL.
WINTER SESSION.
Lecturer.—Dr. C. R. A. Wright, F.C.S. Monday, Tuesday, Thursday, and Friday, at 9 a.m. £5 5s.
SUMMER SESSION.
Practical Chemistry.—Dr. C. R. A. Wright, F.C.S.
Inorganic Course.—Arranged for the requirements of the London University Preliminary Scientific Examination. Tuesday, Friday, and Saturday, at 9 a.m. Fee, £3 3s.
Organic Course.– Arranged to meet the requirements of the London University First M.B. Examination. Tuesday and Friday at 10 a.m. £3 3s.

MIDDLESEX HOSPITAL.
WINTER SESSION.
Lecturer.—Mr. Heisch. Monday, Thursday, and Friday, at 3 ; Saturday, at 11. One session, £6 6s.
SUMMER SESSION.
Practical Chemistry.—Mr. Heisch. Monday and Thursday at 3 ; Friday, at 11.30. One session, £3 3s.

ST. THOMAS'S HOSPITAL.
WINTER SESSION.
Lecturer.—Dr. A. J. Bernays. Wednesday, Thursday, and Friday, at 9. One Course. £5 5s.
SUMMER SESSION.
Practical Chemistry.—Dr. A. J. Bernays. Tuesday and Thursday, 10 to 12 ; Friday, 11 ; Saturday, 10 to 1. One course, £3 3s.

WESTMINSTER HOSPITAL.
WINTER SESSION.
Lecturer.—Dr. A. Dupré, F.C.S. Tuesday and Thursday, at 3 p.m. ; Friday, at 10 a.m. One course, £5 5s.
SUMMER SESSION.
Practical Chemistry.—Dr. A. Dupré, F.C.S. Monday, Wednesday, and Friday, at 10 a.m. One course, £3 3s.

UNIVERSITY OF OXFORD.
Professor of Chemistry.—Dr. Odling, F.R.S.
Demonstrator.—E. Madan, M.A.

A commodious Laboratory is attached to the New Museum.
Scholarships of about the value of £75 are obtainable at Christ Church, Magdalen, and other Colleges, by competitive examination in Natural Science.

UNIVERSITY OF CAMBRIDGE.
Professor of Chemistry.—G. D. Liveing, M.A.
Demonstrator.—J. W. Hicks, M.A.
LECTURES IN MICHAELMAS TERM.
Chemistry, general principles, by the Professor, on Mondays, Wednesdays, and Fridays, at 12.
Spectroscopic Analysis, by the Professor.
Practical Chemistry, by the Demonstrator, daily.
Organic Chemistry, by Mr. Main, at St. John's College
Volumetric Analysis, by Mr. Apjohn, at Gonville and Caius College.
LECTURES IN LENT TERM.
Chemistry, general principles continued, by the Professor, on Mondays, Wednesdays, and Fridays, at 12.
Quantitative Analysis, by the Professor, same days, at 1.
Practical Chemistry, by the Demonstrator, daily.
Elementary Chemistry, by Mr. Main, at St. John's College.
Quantitative Analysis of rarer elements, by Mr. Apjohn, at Gonville and Caius College.
LECTURES IN EASTER TERM.
History of Chemical Philosophy, by the Professor, on Mondays, Wednesdays, and Fridays, at 12.
Quantitative Analysis, same days, at 3.
Elementary Inorganic Chemistry, by the Demonstrator.
Chemistry, continued, by Mr. Main, at St. John's College.
Organic Analysis, by Mr. Apjohn, Gonville and Caius College.
The Chemical Laboratory of the University is open daily, from 10 a.m. until 6 p.m., for the use of Students, under the direction of the Professor. The Demonstrator attends there daily to give instruction in manipulation, alternately in the morning and afternoon.

PROVINCIAL SCHOOLS.

BIRMINGHAM.—MIDLAND INSTITUTE.
Lecturer on Chemistry.—Mr. C. J. Woodward, B.Sc. Tuesday and Thursday, at 8 p.m.
Practical Chemistry.—Mr. C. J. Woodward, B.Sc. Saturday, 3 to 6, and 6.30 to 9.30 p.m.

BIRMINGHAM.—QUEEN'S COLLEGE.
WINTER SESSION.
Professors of Chemistry.—Alfred Hill, M.D., and A. G. Anderson. Tuesday, Thursday, and Friday, at 12.
SUMMER SESSION.
Practical Chemistry.—Professor A. G. Anderson. Thursday and Friday, at 2 p.m.

BLACKBURN SCHOOL OF CHEMISTRY.
Professor of Chemistry.—Mr. George Whewell, F.C.S.

BRISTOL.—BRISTOL MEDICAL SCHOOL.
WINTER SESSION.
Lecturer.—Mr. Thomas Coomber, F.C.S. Monday, Wednesday, and Friday, at 8.30. One Course, £5 5s.
SUMMER SESSION.
Practical Chemistry.– Mr. T. Coomber, F.C.S. Daily, except Saturday, at 8 a.m. One Course, £3 3s.

ROYAL AGRICULTURAL COLLEGE, CIRENCESTER.
CHEMICAL DEPARTMENT.
Professor.—A. H. Church, M.A. Oxon.
Assistant.—R. C. Woodcock, F.C.S.
The Autumn Session commenced on the 13th of August; it divides on the 6th of October, and terminates about the 18th of December.

The Chemical instruction comprises Three Courses of Lectures and Laboratory Practice :—

(1). 32 Lectures on Inorganic Chemistry.
(2). 32 Lectures on Organic Chemistry.
(3). 24 Lectures on Agricultural Chemistry.
(4). 32 Lessons on Chemical Manipulation.
(5). 32 Lessons on Qualitative Analysis.
(6). 32 (or more) Lessons on Quantitative Analysis.

Catechetical Lectures are also given, while analyses of manures, oil-cakes, minerals, soils, waters, &c., are daily performed in the College Laboratories, and Chemico-Agricultural researches undertaken by the more advanced Students, under the immediate direction of Professor Church.

The text-books used are Church's "Laboratory Guide," Roscoe's "Chemistry," and Church and Dyer's edition of "How Crops Grow."

LIVERPOOL ROYAL INFIRMARY SCHOOL OF MEDICINE.

Chemistry and Practical Chemistry.—J. Campbell Brown, D.Sc. Lond., F.C.S.

The first half of the Course, to Christmas, includes all the branches of Chemistry required for the Matriculation Examination of the University of London.

The Course consists of 100 Lectures, and is divided as follows :—

1. Chemical Physics.
2. Chemistry of the Metalloids.
3. Chemistry of the Metals and their Compounds.
4. Organic Chemistry.
5. Technological Chemistry.

Fee for the Course, £5 5s.

Technological and other non-medical Students may take out any of the divisions separately—Fee, £1 1s.; but no certificates will be given until the whole Course has been attended.

Practical Chemistry.—The new Laboratories, which accomodate eighty working Students, are now open, and those who desire to prosecute Practical Chemistry, analysis, or original research, will be provided with separate working-benches and cupboards, with tools, fuel, water, and gas. Fees, from £1 1s. to £4 4s. per month.

The following Classes have been arranged :—

1. Practical Exercises on the Non-Metallic Elements and their Gaseous Compounds. In November and December, at 4 p.m. Fee, £2 2s.
2. Qualitative Analysis of Inorganic Acids and Bases in Solutions containing one of each; Examination of Urine, Bile, Urinary Deposits and Calculi, &c. Monday, Tuesday, and Friday, at 10.30 a.m. Three months, commencing May 1. Fee, £3 3s.
3. Qualitative Analysis of Complex Mineral Substances. Monday and Friday, at 11.30 a.m., commencing May 1. Fee, £3 3s.
4. Practical Exercises in Technology, Pharmaceutical Chemistry, and Toxicology, at 4 p.m., commencing January 14. Fee, £5 5s.
5. Qualitative Analysis of Organic Substances, especially those in the List for 1st M.B. Exam. of Lond. Univ. In April, May, and June. Fee, £3 3s.
6. Quantitative Analysis. Students may enter at any time.

ANALYTICAL LABORATORY AND SCHOOL OF TECHNICAL CHEMISTRY,

7 and 9, HACKIN'S HEY, LIVERPOOL.

Conducted by Mr. A. Norman Tate.

Hours of attendance, 9.30 a.m. to 5 p.m. (Saturdays, 9.30 a.m. to 1 p.m.).

Fees—Three months, £15 15s.; six months, £26 6s.; twelve months, £52 10s.

The Laboratory is also open from October to end of April two evenings per week for Lectures and practical work.

A separate working-bench is provided for each Student, and he is also supplied with all ordinary chemicals, gas, fuel, and the more substantial portions of Laboratory apparatus, but must provide himself with test-tubes, beakers, and other apparatus of a fragile nature.

In addition to the ordinary chemical studies, the Course of instruction will, as far as possible, comprise all such studies as may be required for the successful prosecution of the particular branch or branches of Applied Chemistry in which the pupil is to engage.

LIVERPOOL OPERATIVES' SCIENCE CLASSES

(IN CONNECTION WITH THE GOVERNMENT DEPARTMENT OF SCIENCE AND ART, AND THE OPERATIVE TRADES' HALL, LIVERPOOL).

Session extends from September 16, 1874, to end of April, 1875.

Chairman.—Mr. James Samuelson.
Honorary Secretary.—Mr. Michael Fitzpatrick, 62, Seel Street.
Lecturer on Chemistry and Laboratory Practice.—Mr. Norman Tate.
Assistant Lecturers.—Mr. Percy Hollis and Mr. Hugh Hughes.
Lecturer on Physics.—Mr. Gordon.

Classes for the study of Inorganic Chemistry and Laboratory Practice will meet on Wednesday evenings in the School-Board Schools, Queen's Road, and on Friday evenings at Mr. Tate's Laboratory, 9, Hackin's Hey. Other Chemical Classes are being organised.

Classes for the study of Acoustics, Light and Heat, Electricity and Magnetism, &c., will meet under the care of Mr. Gordon in the National Schools, Everton Valley.

Arrangements have been made whereby teachers and pupil teachers of public elementary schools will be admitted to the Chemistry Classes at a nominal fee of one shilling. The fees to other pupils are (not including use of glass and fragile apparatus)—

For each Course of Lectures—Artisans, Half-a-Crown; Non-Artisans, One Guinea.

For each Course of Laboratory Practice—Artisans, One Guinea; Non-Artizans, Three Guineas.

All Pupils are expected to present themselves at the next May Examination of the Science and Art Department.

COLLEGE OF CHEMISTRY, LIVERPOOL.

Principal.—Mr. Martin Murphy, F.C.S., Professor of Chemistry.

The Course of instruction given in the College of Chemistry comprises the teaching of Chemistry as a science, and the general application of chemical knowledge; also the teaching of the principles of those branches of physics which are allied with Chemistry, such as light, heat, electricity, &c.

Particular attention is devoted to instruction in the practice of systematic analytical operations, whereby Students will be enabled to determine accurately the general and proximate constituents of substances, and so arrive at a knowledge of their nature and properties.

Instruction in the application of chemical data to medicine and agriculture, and to the chemical and metallurgical operations, comprising Technology, will be given, to qualify Students for these avocations.

The Students will invariably be controlled and directed in their study and work by the Principal and competent assistants. Ample Laboratory accommodation is provided for Students, and such general appliances as will facilitate their progress in acquiring a knowledge of the specialities taught in the College.

The Students' Laboratories are open throughout the year. Hours of attendance—From 10 a.m. to 5 p.m. daily. Fees—10 guineas per quarter of three months, or 35 guineas per annum, payable in advance. Students provide all their own apparatus and books.

Medical and Pharmaceutical Students are admitted for one hour per day. Fee for three months, £2 2s.

A Course of Lectures will be delivered to the Students during the winter months. Evening Classes.

Certificates of attendance recognised by the University and Apothecaries' Hall of London, and Apothecaries' Hall of Ireland.

LEEDS SCHOOL OF MEDICINE.

WINTER SESSION.

Lecturer.—Mr. Thomas Fairley, F.C.S.

Daily, except Wednesday and Saturday, at 11 a.m. First Session, £4 4s. Second Session, £3 3s.

SUMMER SESSION.

Practical Chemistry.—Mr. Fairley, F.C.S.

Mondays and Tuesdays, 9.30 to 11. Each Course, £3 3s.

General Chemical Students.—The Laboratories are open daily, under the direction of Mr. Fairley, for the instruction of General Students in Chemical Manipulation, Technical Chemistry, and all branches of analysis ; and also for the use of gentlemen wishing to pursue special chemical researches.

The fees, payable in advance to the Treasurer, are as follows :—For one month, £4 4s.; for two months, £7 7s.; for three months, £10 10s.; for four months, £13 13s.; for five months, £15 15s.; for six months, £17 17s.; for nine months, £21. Special fees will be charged to Students who do not wish to work every day in the week.

The Chemical Museum contains minerals, metallic ores and metals, rare chemical substances, and illustrations of the most important chemical manufactures in their different stages.

Curator.—Mr. Scattergood.

LEEDS MECHANICS' INSTITUTION AND LITERARY SOCIETY'S LABORATORY.

Chemical Classes and Laboratory for Instruction in Elementary, Practical, and Analytical Chemistry, commence on Friday, September 25, at 8 p.m.

Lecturer.—Mr. George Ward, F.C.S., with Assistants.

YORKSHIRE COLLEGE OF SCIENCE, LEEDS.

Professor of Chemistry.—Dr. T. E. Thorpe, F.R.S.E.

Professor of Physics and Mathematics.—A. W. Rücker, M.A.

HIGH HARROGATE COLLEGE, YORKSHIRE.

Professor of Chemistry.—Mr. W. G. Mason, F.C.S., Certificated Science Teacher.

MANCHESTER GRAMMAR SCHOOL.

CHEMICAL DEPARTMENT.

Professor.—Francis Jones.

Instruction is given in Inorganic Chemistry, Organic Chemistry, Metallurgy, and Analytical Chemistry. There is a lecture-room and second Laboratory, affording accommodation for seventy-two Students.

OWENS COLLEGE, MANCHESTER.

Professor and Director of the Chemical Laboratories.— H. E. Roscoe, B.A., Ph.D., F.R.S., F.C.S.

Professor C. Schorlemmer, F.R.S.

Demonstrator and Assistant Lecturer.—Mr. W. Dittmar, F.R.S.E.

Assistant Demonstrators.—Mr. W. Carleton Williams, F.C.S., and Mr. Harry Grimshaw, F.C.S.

Lecture Courses.

Systematic Chemistry.—*Junior Class*—Tuesday, Thursday, and Saturday, from 9.30 to 10.30 a.m., during Michaelmas and Lent Terms. Comprising—(1) The laws of Chemical Combination ; (2) a description of the physical and chemical properties and the mode of preparation of the Non-Metallic Elements and of their compounds.

Senior Class.—Monday, Wednesday, and Friday, from 9.30 to 10.30 a.m., during the Michaelmas and Lent Terms, comprising—(1) The Chemistry of the Metals and of their most important compounds ; (2) Organic Chemistry, giving the composition and relations of the best defined groups of organic bodies and the laws regulating their formation.

The instruction in Systematic Chemistry is given by means (*a*) of Experimental Lectures and (*b*) of Tutorial Classes. The Tutorial Classes will meet for recapitulation, and for the correction of the written exercises given out in the Lectures, at times to be fixed at the commencement of the Session.

Fee—For each Class, £2 12s. 6d.; for both Classes, £4 14s. 6d.

A Tutorial Class, meeting in Sections, will also be held, which all members of the Junior and Senior Classes will be required to attend, unless specially exempted by the Principal and the Professor. Extra fee for this Class, 10s. 6d. This fee is not included in the composition fees payable by regular Students.

Organic Chemistry.—Professor C. Schorlemmer, F.R.S. Tuesday, Thursday, and Friday, from 2.30 to 3.30 p.m.

The subject of this Course is the Chemistry of the Carbon Compounds, wherein the branch of Organic Chemistry is more fully and completely treated than in the general Course in Systematic Chemistry.

Fee, £3 10s.

Technological Chemistry.—Wednesday, from 2.30 to 3.30 p.m.

The chemical principles involved in the most important Chemical Manufactures will chiefly be considered in this Course. The subject will be discussed as follows :—

1. Ten Lectures on the Modes of Producing and Utilising Heat and Light, by Mr. Dittmar.

2. Ten Lectures on Water and Air and the Chemistry of the Alkali Manufacture, by Professor Roscoe.

3. Ten Lectures on the Chemistry of Colouring Matter, Dyeing and Calico Printing, by Professor Schorlemmer.

Students attending this Class must be acquainted with the principles of chemical science.

Fee, £1 11s. 6d.

Chemical Philosophy.—Professor C. Schorlemmer, F.R.S Saturday, from 9.30 to 10.30 a.m.

Sketch of the History of Chemistry ; Development of Modern Chemistry ; Chemical Laws and Theories ; Relation of Chemistry to Physics.

Fee, £1 11s. 6d.

Analytical Chemistry.—Mr. W. Dittmar, F.R.S.E. Wednesday, from 9.30 to 10.30 a.m.

This Course will treat of the methods of Qualitative and Quantitative Analysis, and is intended to supplement the instruction in Practical Chemistry.

All first year's Laboratory Students are required to attend this Class, and to perform the written exercises and to answer the *viva voce* questions given out.

Fee, £1 11s. 6d.

Analytical and Practical Chemistry.

LABORATORY COURSES.

The Chemical Laboratories will be open for Students daily from 10.30 a.m. until 5.30 p.m., except on Saturdays, when they will be closed at 1.30 p.m.

The Laboratories are fitted with every convenience for the prosecution of Practical Chemistry, all branches of Qualitative and Quantitative Analysis, and original research. Each Student is provided with a separate working-table, a set of tests, fuel, water, and gas, free of expense ; but he is required to find his own apparatus, a few of the more expensive reagents, and the chemicals required for his experiments. Other apparatus or instruments of a more expensive description may be obtained on loan from the Laboratory Steward, subject to regulations to be prescribed by the Professor.

Regular Students, or those preparing for Degrees, may enter for two days a week at a fee of £9 9s. All other Students will be required to enter according to the following scale, and those working in the Quantitative Laboratory will be required to enter for not less than four days per week.

Fees for the Session—For six days per week, £21 ; for four days per week, £17 17s.; for three days per week, £13 13s. Students entering the Laboratory Class at or

after Christmas will be charged two-thirds of the fees for the whole Session.

Fees for shorter periods—For six months, £17 17s.; for five months, £15 15s.; for four months, £13 13s.; for three months, £10 10s.; for two months, £7 7s.; for one month, £4 4s. Students entering under this scale are entitled to work on every day during the week.

EVENING CLASSES.
Chemistry.

First Lecture Course.—(The Non-Metallic Elements).— Professor Roscoe. Monday, from 8.35.

Second Lecture Course.—(The Metals).—Mr. Williams. Friday, from 8.5 to 9.5 p.m.

Third Lecture Course.—(Organic Chemistry).—Mr. Schorlemmer. Monday, from 8.5 to 9.5 p.m.

Technological Chemistry.—(Sulphuric Acid, Alkalies, &c.).—Mr. Dittmar. Thursday from 7 to 8.

Laboratory Courses.— Professor Roscoe and Mr. Williams. Monday, from 6 to 8.30 p.m.

QUEENWOOD COLLEGE,
NEAR STOCKBRIDGE, HANTS.

The Science Department of the above College is under the direction of Frank Clowes, B.Sc. Lond., F.C.S. Lectures are delivered during term time on Chemistry and Natural Philosophy, and a well-appointed Chemical Laboratory is used by all but the youngest pupils. The Course of Instruction is well suited to meet the requirements of the London University and College of Surgeons Examinations.

Principal.—C. Willmore.

COLLEGE OF PHYSICAL SCIENCE, NEWCASTLE.
(IN CONNECTION WITH THE UNIVERSITY OF DURHAM.)

Experimental Physics.—Professor A. S. Herschel, B.A., F.R.A.S. First Year Course—Mechanics, Sound, Heat, and Steam. Monday, Wednesday, and Friday, at 3 p.m. Second Year Course—Light, Magnetism, and Electricity. Tuesday and Thursday, at 3 p.m.

Experimental Lectures, and Questions for written Exercises, will be given at each meeting of the Class. Occasional visits to Mining and Manufacturing Establishments, to see the operation of Physical Processes described in the demonstrations of this Course, and the Course of the previous year, will be arranged, from time to time, during the Session. Fee, £5 5s.

Physical Laboratory.—The Physical Laboratory, for Physical Experiments, is open daily, from 10 a.m. to 5 p.m., excepting on Saturdays, when it closes at 1 p.m. Fees—Attendance per day weekly, £1 1s. per term.

Chemistry.—Professor—A. Freire-Marreco, M.A. Demonstrator—E. Haigh, Assoc. Phys. Science.

Junior Division.—General Principles of Chemistry; History of the Non-Metallic Elements. History of the Metals and their more important compounds; Principles of Qualitative Analysis. Monday, Wednesday, and Friday, at 11 a.m.

Senior Division.—Elements of Organic Chemistry, Tuesdays, at 11 a.m. Applied Chemistry, Thursdays, at 11 a.m. Fee, £5 5s.

Practical Chemistry.—The Laboratory is open from 10 a.m. to 1 p.m., and from 2 to 5 p.m., except on Saturdays, when it closes at 1 p.m. *Laboratory Fees.*— Students working six days per week, £5 5s. per term; alternate days, £3 3s.; one day per week, £1 1s.

Arrangements for Laboratory work in the evening and during vacation will be made.

Courses of Study.—Students will be distinguished into Regular and Occasional. Regular Students will be required to follow such a course of study in the subjects professed in the College as will enable them to pass the Examinations for the title of Associate in Physical Science. Occasional Students will attend such classes as they may select.

The Session will commence on the 5th of October, 1874.

In addition to the class-fees, Students will be required to pay an entrance fee of £1 1s. Students who do not enter to more than two classes may commute this on payment of seven shillings entrance fee for each Course.

Students desirous of studying the whole of the four subjects professed in the College—viz., Mathematics, Experimental Physics, Chemistry, and Geology—may compound for the class fees, by payment of £17 17s.

Evening Classes.—Professor A. Freire-Marreco, M.A. Twelve Lectures on Inorganic Chemistry. Mondays, at 7.45, commencing November 2, 1874.

BOROUGH ANALYST'S LABORATORY,
1 and 3, SURREY STREET, SHEFFIELD.

Mr. A. H. Allen, F.C.S., delivers a Course of Thirty Lectures on Inorganic Chemistry and Metallurgy. Day and Evening Classes for the practice of Analytical Chemistry and Assaying.

SHEFFIELD SCHOOL OF MEDICINE.

A Course of Forty-five Lectures on Inorganic and Organic Chemistry will be delivered during the Winter Session, by A. H. Allen, F.C.S.

The Summer Course of Practical Chemistry is conducted by Mr. Allen.

SCOTLAND.

UNIVERSITY OF EDINBURGH.

Professor of Chemistry.—Dr. A. Crum Brown, F.R.S.E.

SCHOOL OF MEDICINE, EDINBURGH.

Lecturer on Chemistry.—Dr. Stevenson Macadam, F.R.S.E.

The Courses of Instruction in Chemistry include its applications to Medicine, Agriculture, and the Industrial Arts; and they qualify for the University of Edinburgh and other Universities, the Royal Colleges of Physicians and Surgeons, the Navy, Army, and Indian Medical Service, and the other Medical and Public Boards.

UNIVERSITY OF GLASGOW.

Professor of Chemistry and Practical Chemistry.—Dr. Thomas Anderson, F.R.S.E.

ANDERSON'S UNIVERSITY, GLASGOW.

Professor of Scientific Chemistry.—Dr. T. E. Thorpe.

THE "YOUNG" CHAIR OF TECHNICAL CHEMISTRY,
ANDERSON'S UNIVERSITY, GLASGOW.

Professor.—Gustav Bischof.

This Chair has for its object the Instruction of Students in Chemistry as applied to the various branches of Industry in Chemical and other works, Metallurgy, Agriculture, &c.

In addition to the practical working in the Laboratory, Students have the advantage of attending Lectures on the various subjects of Technical Chemistry.

The outline of the Course of Lectures, which are illustrated by Experiments, Specimens, and Diagrams, and which will be completed in three consecutive Sessions, is as follows:—

First Session.—Crude Materials and Products of Chemical Industry, such as compounds of Potassium, Sodium, Sulphur, Chlorine, Ammonium, &c.; Glass, Ceramic Ware, Gypsum, Lime, and Mortar.

Second Session.—Vegetable Fibres and their Technical Application; Animal Substances and their Technical Application; Food; Dyeing and Printing; Materials and Apparatus employed for producing Artificial Light and Heat.

Third Session.—Chemical Metallurgy, Extraction of the Metals from their Ores, and Technical Application of Metals and Metallic Compounds.

The Session commences on the first Tuesday in November, and closes on the last day of July.

The Laboratory is open daily, from 10 to 4, and on Saturdays from 10 to 1 o'clock, for practical working by the Students, under the superintendence of the Professor and his Assistants.

The Fees for attending the Laboratory and Lectures are £18 per Session, £13 for six months, £7 for three months, or £2 10s. per month.

Students are supplied with a working table containing the ordinary reagents required for analysis, and such apparatus as retort stands, gas jets, &c. Small articles, such as Berlin porcelain evaporating basins, funnels, retorts, flasks, beakers, &c., Students are required to provide for themselves. Larger and more expensive apparatus, such as large evaporating basins, retorts, flasks, bottles, funnels, thermometers, &c., are lent for experiments. Students must be sixteen years of age on application, of good moral character, and, in addition to the ordinary branches of an English education, must be acquainted with the elementary principles of Chemistry. Further information may be obtained of the Professor, at the Laboratory, Anderson's University, 234, East George Street.

Bursaries.—The Trustees of the " Young " Chair have the superintendence of the Bursaries—regulating the appointment and terms on which they shall continue to be held. The Bursaries are of the amount of £50 each per annum, tenable for three years. during which the Bursars shall be required to give their whole time and attention to the Lectures and Laboratory duties of the " Young " Chair, paying the ordinary fees.

GLASGOW MECHANICS' INSTITUTION.

Professor of Chemistry and Practical Chemistry.—Mr. R. R. Tatlock, F.C.S.

SCHOOL OF CHEMISTRY.
42, BATH STREET, GLASGOW.

Dr. Wallace, Mr. Tatlock, and Dr. Clark.

CHEMICAL LABORATORY AND CLASS ROOMS.
144, WEST REGENT STREET, GLASGOW.

Conducted by Dr. Milne.

The Laboratory is open daily from 10 to 4 (Saturdays excepted), for Instruction in Practical and Analytical Chemistry. Fee for six months, exclusive of apparatus, £10 10s. Fee for one month, £2 2s. Private Pupils (number limited to three), per month, £4 4s. Students can join the Laboratory at any time.

The Practical Evening Classes for Instruction in Analysis and Testing will meet on Tuesdays and Thursdays, from 7 p.m. till 9 p.m., commencing November 3. Fee for one night per week, including apparatus and material, £1 1s. per quarter. Fee for two nights per week, £2 2s.

IRELAND.

DUBLIN.—TRINITY COLLEGE.
Professor of Chemistry.—Dr. Apjohn, F.R.S.

ROYAL COLLEGE OF SURGEONS, DUBLIN.
Professor of Chemistry.—Dr. Barker.

QUEEN'S COLLEGE, BELFAST.
Professor of Chemistry.—Dr. Andrews, F.R.S., &c.

QUEEN'S COLLEGE, GALWAY.
Professor of Chemistry.—Dr. T. H. Rowney.

A Laboratory for Practical Instruction is attached to all the Queen's Colleges. The usual Practical Course for the Medical Boards is given in the summer.

ROYAL COLLEGE OF SCIENCE FOR IRELAND.
STEPHEN'S GREEN, DUBLIN.

This College supplies, as far as practicable, a complete Course of Instruction in Science, applicable to the Industrial Arts. The subjects of Instruction are :—Pure and Applied Mathematics, Descriptive Geometry and Mechanical Drawing, Mechanism, Theoretical and Applied Chemistry, Chemical Analysis, Physics, Botany, Zoology, Geology and Palæontology, Mineralogy, Mining, Machinery, Surveying, and Agriculture.

Professor of Theoretical and Practical Chemistry.—R. Galloway, F.C.S.

Professor of Experimental Physics.—W. F. Barrett, F.R.S.E., F.C.S.

The Chemical and Metallurgical Laboratories, under the direction of Mr. Galloway, are open every week day during the Session, except Saturday. Instruction is given in the different branches of Analytical Chemistry, including Assaying, and in the methods for performing Chemical Research. Each Student is taught, not in class, but separately and independently; and he is supplied with a separate working table, with reagents, fuel, water, gas, and the larger and more expensive apparatus. Fee, for the Session of nine months, £12; or for three months, £5; or for one month, £2.

There are four Royal Scholarships of the value of £50 each yearly, with free Education, including Laboratory Instruction, tenable for two years; two become vacant each year; they are given to Students who have been a year in the College. There are also nine Exhibitions attached to the College, of the yearly value of £50 each, with free Education, including Laboratory Instruction. tenable for three years; three become vacant each year, The Exhibitions are awarded at the Annual May Examinations of the Science and Art Department.

A Diploma of Associate of the College is granted at the end of the three year's course.

The Session commences on Monday, October 5th.

CORRESPONDENCE.

A READY METHOD OF DETECTING MEAT-FATS MIXED WITH BUTTER.

To the Editor of the Chemical News.

SIR,—As far back as November and December, 1861, I published in the CHEMICAL NEWS several papers on this subject, which at the time created some discussion between myself and Dr. Ballard, and as the other day when I was in London I heard that the practicability of my method was disputed, and that the question of fats in butter was still unsolved, I have since directed further attention to the matter, and am happy to say that I have been eminently successful.

My starting-point was that fresh butter was permanently soluble in methylated ether, sp. gr. 0·730, at the temperature of 65° F. But with the view of seeing if any other substance it may contain could be precipitated from it, I took, say, 20 or 25 grains of fresh butter, placed it in a small test-tube, and poured over it 1 dram of methylated ether, and on corking the tube it readily dissolved after a few moments agitation. I then added 30 drops of methylated alcohol, 63° O.P., and agitated again, but nothing was precipitated. I therefore made another experiment with 15 grains of fresh butter, and 10 grains of prepared mutton fat, dissolved them in 1 dram of ether first, and added 30 drops of alcohol, when in less than half an hour the fat was precipitated, in a room heated to 680° F.

Next, in order to see the effect upon mixtures of known fats, such as lard, beef, mutton, and tallow fats, properly melted together in proportions of 60 grains of butter and 40 of fat, and stirring till cold, I found that each of them could, by a similar procedure, be precipitated in a few minutes.

In one case, that of mutton, I filtered off the etherial

liquid, and collected the residue, and obtained as much as 30 per cent of what had been used; so that there is no longer any doubt about easily detecting fatty adulterations in butter.

I have exhibited my experiments before various tradespeople, and all have expressed delight at their success.

Something has recently been stated by certain parties as to the estimation of butyric acid; but for my part, I do not think much of that, seeing that we can now deal with the fats in such a simple and more direct way. Lastly, I would observe that crystallisation of butter out of the etherial solution at a lower temperature than 65°, must not be mistaken for the fats precipitated by alcohol alluded to, as the butter, besides being so much lighter, occupies the upper layer, and is different in character, and easily re-melted by the application of the warm hand for a minute or so.—I am, &c.,

JOHN HORSLEY, F.C.S.
Analyst to the County and
City of Gloster.

Cheltenham, September 4, 1874.

NOTES AND QUERIES.

Pyro-Naphthalin.—Will you or some of your numerons correspondents kindly inform me from what source pyro-naphthalin is prepared, and how? stating also the uses of the same, and any additional information. The above will greatly oblige.—M. D.

TO CORRESPONDENTS.

*** Vol. XXIX. of the CHEMICAL NEWS, containing a copious index, is now ready, price 11s. 4d., by post, 12s., handsomely bound in cloth, gold lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxx. commenced on July 3rd, and will be complete in twenty-six numbers. READING CASES, price 1s. 6d. each, post free, may also be obtained at the Office.

Royal Veterinary College.—Opening of the WINTER SESSION.

The LECTURES at this Institution will COMMENCE on THURSDAY, October 1.

The Chair will be taken by C. N. NEWDEGATE, Esq., M.P., who will distribute the medals, &c., to the successful candidates for the Coleman Prize, and also the certificates to the office-bearers of last Session.

The Introductory Address will be delivered by Professor Tuson, at one o'clock.

Lectures, Clinical and Pathological Demonstrations, and General Instruction are given on Pathology of the Horse and other domesticated animals, including Epizootics, Parasites, and Parasitic Diseases; also on Anatomy, Physiology, Histology, Chemistry (General and Practical), Materia Medica, Toxicology, Botany, Therapeutics, and Pharmacy, Hospital Practice, Obstetrics, Operative Surgery, the Principles and Practice of Shoeing, &c.

Students are required to attend one Summer and two Winter Sessions at least before being eligible for Examination for the Diploma of the Royal College of Veterinary Surgeons.

The Matriculation Examination is conducted by the College of Preceptors. Fee, One Guinea.

College entrance fee, Twenty-five Guineas; the payment of which confers the right of attendance on all the Lectures and Collegiate Instructions, with the exception of Practical Chemistry.

The Matriculation Examination of pupils will take place on September 29, at ten a.m.

Candidates who elect to be examined on any of the voluntary subjects are requested to inform the Principal of such intention, and to name the subject not later than September 20.

A Prospectus, containing the rules of the College and copies of the examination papers set last September, will be forwarded on application to the Principal.

A Life Subscriber of Twenty Guineas, or one of Two Guineas annually, to the institution is entitled to have admitted into the Infirmary for medical and surgical treatment an unlimited number of horses or other animals, his own property, at a charge only for their keep. Also to have the opinion of the Professors as to the treatment of any animal he may desire to retain in his own possession without the payment of fees.

JAMES B. SIMONDS, Principal.

August 17, 1874.

University of Aberdeen.—Chancellor, His Grace the Duke of Richmond. *Vice-Chancellor and Principal*, the Very Rev. P. C. Campbell, D.D. *Lord Rector*, T. H. Huxley, LL.D., F.R.S.

FACULTY OF MEDICINE—SESSION 1874-75.

WINTER SESSION, Commencing on Wednesday, October 28.
Anatomy—Professor Struthers, M.D. 11 a.m. £3 3s.
Practical Anatomy and Demonstrations—Professor Struthers and Demonstrator. 9 to 4, and 9 a.m. £2 2s.
Chemistry—Professor Brazier. 3 p.m. £3 3s.
Institutes of Medicine—Professor Ogilvie, M.D. 4 p.m. £3 3s.
Surgery—Professor Pirrie, C.M., .FR.S.E. 10 a.m. £3 3s.
Practice of Medicine—Professor Macrobin, M.D. 3 p.m. £3 3s.
Midwifery and Diseases of Women and Children—Professor Inglis, M.D. 2 p.m. £3 3s.
Zoology with Comparative Anatomy—Professor Nicol, F.G.S. 2 p.m. £3 3s.
Medical Logic and Medical Jurisprudence—Professor Ogston, M.D. 9 a.m. £3 3s.
SUMMER SESSION, Commencing on the First Monday of May.
Botany—Professor Dickie, M.D. 9 a.m. £3 3s.
Materia Medica (100 lectures)—Professor Harvey, M.D. 3 and 4 p.m. £3 3s.
Practical Pharmacy—Professor Harvey and Assistant. £2 2s.
Practical Anatomy and Demonstrations—Professor Struthers and Demonstrator. 9 to 4, and 2 p.m. £2 2s.
Practical Chemistry—Professor Brazier. 10 a.m. £3 3s.
Zoology with Comparative Anatomy—Professor Nicol. 11 a.m. £3 3s.
The Anatomical Course in Summer includes instruction in General Anatomy and in the use of the Microscope; and instruction in Osteology for Beginners.
Matriculation Fee (including all dues) for the Winter and Summer Sessions, £1. For the Summer Session alone, 10s.
Pathological Anatomy—Dr. Rodger. £2 2s.
Practical Ophthalmology—In Summer, Dr. A. D. Davidson.
Dental Surgery—In Summer, Mr. Williamson.
Royal Infirmary: Daily at Noon. Physicians—Drs. Smith-Shand, Beveridge, and A. Fraser. Surgeons—Drs. Pirrie, Kerr, and Ogston. Junior Surgeon—Dr. Will. Ophthalmic Surgeon—Dr. A. D. Davidson. Dental Surgeon—Mr. Williamson. Pathologist—Dr. Rodger. Pepetual Fee to Hospital Practice, £6; or, first year, £3 10s.; second year, £3.
Clinical Medicine—Drs. Smith-Shand, Beveridge, and A. Fraser. £3 3s.
Clinical Surgery—Drs. Pirrie, Kerr, and Ogston. £3 3s.
General Dispensary and Lying-in and Vaccine Institution: Daily. Eye Institution: Daily.
Practical Midwifery, under the superintendence of Dr. Inglis.
Royal Lunatic Asylum: Physician—Dr. Jamieson. Clinical Instruction is given for Three Months in the Year.

The Regulations relative to the Registration of Students of Medicine, and the granting of Degrees in Medicine and Surgery, may be had of Dr. MACROBIN, Dean of the Faculty of Medicine.

Full information regarding the Classes and Degrees in the Faculties of Arts, Law, and Divinity, and in regard to Bursaries and Scholarships, will be found in the UNIVERSITY CALENDAR, published by Messrs. WYLLIE & SON, Union Street, Aberdeen. – By post, 2s. 2d.

Royal College of Science for Ireland, Stephen's GREEN, DUBLIN.

SCIENTIFIC AND TECHNICAL EDUCATION.

This College supplies a complete course of instruction in Science, applicable to the Industrial Arts, especially those which may be classed broadly under the heads of CHEMICAL MANUFACTURES, MINING, ENGINEERING, and AGRICULTURE.

A Diploma of Associate of the College is granted at the end of the Three Years' Course.

There are Four Royal Scholarships, of the value of £50 each yearly, with free education, including Laboratory instruction, tenable for two years. Two become vacant each year. They are given to Students who have been a year in the College.

The Fees are £2 for each Course, or £10 for all the Courses of each year, with the exception of Laboratory.

Chemistry (Theoretical and Practical), Metallurgy, &c.—Professor Robert Galloway, F.C.S.
Mathematics, Mechanics, and Mechanism—Professor Robert Ball, LL.D., F.R.S.
Drawing, Engineering, and Surveying—Professor Thomas F. Pigot, C.E., M.R.I.A.
Experimental Physics—Professor W. F. Barrett, F.R.S.E., F.C.S.
Geology—Professor Edward Hull, M.A., F.R.S.
Mining and Mineralogy—Professor J. P. O'Reilly, C.E., M.R.I.A.
Agriculture—Professor Edmund W. Davy, M.D., M R.I.A.
Botany—Professor W. R. M'Nab, M.D.
Zoology—Professor H. Alleyne Nicholson, M.D.

The Session commences on Monday, October 5th.

Programmes may be obtained on application to the Secretary, Royal College of Science, Stephen's Green, Dublin.

FREDERICK J. SIDNEY, LL.D., Secretary.

THE CHEMICAL NEWS.

VOL. XXX. No. 773.

NOTES ON THE OCCURRENCE OF ALUMINIUM IN CERTAIN CRYPTOGAMS.

By Professor A. H. CHURCH, M.A.

ALL the more recent and exact analyses of the ashes of plants show that the element aluminium is not to be found amongst the constituents of flowering plants, and that its presence is confined to a few of the cryptogams. During the last two years I have been endeavouring to give greater precision to our knowledge of this subject, and through the kindness of various friends, including Dr. Hooker, of Kew, and Dr. McNab, of Dublin, I have been enabled to secure authentic specimens of the different species of plants which I deemed it important to analyse. My researches are by no means finished, but I have obtained results of so interesting and decisive a bearing that I think they should be made known at once, even if incomplete.

In undertaking an enquiry of this nature, there are three conditions of success which must be rigorously fulfilled : the plants must be absolutely freed from all extraneous matter previous to incineration ; the process for the determination of the alumina must be accurate, and must not allow traces of this earth to escape precipitation ; and the reagents and apparatus must not introduce any alumina. The first condition was fulfilled by a system of washing and brushing the various plants operated upon, and analysing the material experimented on in different stages of purification ; it may be noted here that, in the case of the plants in which aluminium occurs, more was invariably found in the completely washed than in the partially washed samples. The second condition was answered by the use of the well-known sodium hydrate and barium chloride process, as described in my " Laboratory Guide," 3rd edition, p. 137 ; while the third condition merely required the use of pure reagents, such as sodium hydrate made from sodium, and of silver vessels instead of those of glass generally employed.

Before giving my chief results, a word must be said as to the work already done in this direction. So far as I know, aluminium has not been detected in the ashes of any plants save four, or possibly five, and in one or two of these cases we lack information as to the purity of the reagents employed ; indeed, in most of them we may be sure that the sodium hydrate was *not* prepared from pure sodium. On this account, I could not regard the recorded discovery of 1 or 2 per cent of Al_2O_3 in the ash of some of the plants analysed as conclusive of the occurrence of this constituent amongst those essential to the plant itself. For instance, in 1856, Solms Laubach (*Ann. Chem. Pharm.*, c., 297) found in the ash of the *Lycopodium denticulatum* of gardens (really a *Selaginella*, the *S. Kraussiana*, of Kunze) 42 per cent of silica and 2·0 per cent of alumina, a small proportion, it will be seen, of the latter earth, and one due very likely to its introduction from the reagents and the glass vessels used. But when Ritthausen (*Journ. Prakt. Chem.*, lviii., 13), in 1853, found 39·07 per cent of alumina in the ash of *Lycopodium chamæcyparissus*, and 20·69 per cent in that of *L. clavatum*, it was obvious that there was no room to doubt the fact that alumina formed an important part of the fixed constituents of the plants analysed. Further, the above results confirmed others previously obtained (1851 and 1852), and have met since with general acceptance. What I have at present done has been to examine other species of the same genus, *Lycopodium*, and a few plants belonging to closely-allied genera.

My first experiments were made upon two British Lyco-

podia, *L. clavatum* and *L. alpinum*, abundant supplies of these club-mosses in fruit having been obtained from a mountain district in Westmoreland. A quantity of plants of each species was cleansed by careful brushing, and the material thus prepared was burnt and the ash analysed. Other portions were then brushed and washed in a stream of cold distilled water, and then burnt, the ash being examined as in the first instance. A third portion of each kind was then purified by the most thorough brushing and washing, so that every particle of foreign matter was entirely removed. The ash in the samples which had been brushed merely, and in those also which had been further purified, was greater in amount, but contained *less alumina*, than the ash of the completely purified samples. As further washing neither lessened the ash, nor increased its percentage of alumina, it was considered that all extraneous matter had been removed. The following percentages were finally obtained :—

	Percentage of Ash in Dry Plant.	100 parts of Ash contained	
		Al_2O_3.	SiO_2.
Lycopodium alpinum ..	3·68	33·50	10·24
L. clavatum	2·80	15·24	6·40

These results really agree with those of Ritthausen ; for *L. alpinum* is a species closely allied to *L. chamæcyparissus*, in which he detected 39·07 per cent of Al_2O_3, while my determination in the case of *L. clavatum* is not much lower than his, viz., 15·24 per cent of Al_2O_3 in lieu of 20·69.

The next point to be settled was the absence or presence of alumina in the species of the closely allied genus *Selaginella*. I obtained a good supply of *S. Martensii*, var. *robusta* (the var. γ *compacta* of A. Braun), and thoroughly cleansed it previous to analysis. It gave—

	Percentage of Ash in Dry Plant.	100 parts of Ash contained	
		Al_2O_3.	SiO_2.
Selaginella } *Martensii* } ..	11·66	0·26	41·03

Practically, this ¼ per cent of Al_2O_3 must be regarded as accidental, and we may conclude that this constituent is absent from the plant in question.

Further, to see whether alumina is really distinctive of *Lycopodium*, and is always absent from *Selaginella*, other trials were made. A quantity of another species of *Lycopodium*, *L. Selago*, was obtained from Westmoreland, and cleansed and burnt with the following results :—

	Percentage of Ash in Dry Plant.	100 parts of Ash contained	
		Al_2O_3.	SiO_2.
L. Selago	3·20	7·29	2·53

A result perfectly confirming my former conclusions, and the more particularly so, as the group of Lycopodia to which *L. Selago* belongs is separated from the group to which *L. alpinum* belongs by that to which *L. clavatum* belongs, thus :—

Botanical Series.	Order. According to Percentage of Alumina.		
1. .. *L. alpinum.*	1.	33·50
2. .. *L. clavatum.*	2.	15·24
3. .. *L. Selago.*	3.	7·29

Now there is a most interesting British *Selaginella*, the only species found in these islands, and a plant which has been ranged amongst the *Lycopodia* until the last few years, when it was separated on account of its mode of reproduction. This plant, formerly known as *Lycopodium selaginoides*, is now called *Selaginella spinulosa*. If the element aluminium be really confined to the genus *Lycopodium*, this plant ought not to contain it—and it does not, according to the following analysis :—

	Percentage of Ash in Dry Plant.	100 parts of Ash contain	
		Al_2O_3.	SiO_2.
Selaginella spinulosa ..	3·44	none	6·67

A good supply of this plant was kindly obtained for me from Largo Links, Fife, by Mr. Howie, of Largo.

Many points remain to be determined by further research concerning this occurrence of aluminium in species of *Lycopodium*. Is the proportion in any one kind as fairly constant in quantity as the other constituents of the ash? Is the element present in every kind of *Lycopodium?* I have commenced the study of another point connected with the present inquiry, and have searched for and failed to find alumina in the ashes of the following cryptogams, more or less nearly related to *Lycopodium*:—

> *Equisetum maximum.*
> *Ophioglossum vulgatum.*
> *Psilotum triquetrum.*

I hope to analyse species of *Phylloglossum* and *Tmesipteris*, two genera of *Lycopodieæ* closely allied to *Lycopodium*. *Isoetes*, also, which is separated from *Lycopodium* by *Selaginella*, should also be studied in this connection.

In the following table, the results recorded in the present paper are presented in a compact form :—

	Percentage of Ash in Dry Plant.	100 parts of Ash contain	
		Silica.	Alumina.
Lycopodium alpinum ..	3·68	10·24	33·50
L. clavatum	2·80	6·40	15·24
L. Selago	3·20	2·53	7·29
Selaginella Martensii..	11·66	41·03	0·26
Selaginella spinulosa ..	3·44	6·67	none
Equisetum maximum ..	20·02	62·95	none
Ophioglossum vulgatum	8·25	5·32	none
Psilotum triquetrum ..	5·06	3·77	trace (?)

ON THE COMPOSITION OF AN INFLAMMABLE GAS ISSUING FROM THE SILT-BED IN BELFAST.

By Dr. ANDREWS, F.R.S.

IN sinking for a well upon the premises of Messrs. Cantrell and Cochrane, in George's Lane, Police Square, Belfast, after having passed through a deposit of silt to the depth of 33 feet, a layer of gravel was reached, seven feet in thickness, and containing a quantity of organic *debris*. It rested upon a thick deposit of very tenacious clay. On entering the gravel-bed, a large flow of water occurred, which rose to within four feet of the surface of the ground, and interrupted the operation of boring, till a pump, worked by a small steam-engine, was erected, which, so long as it was in action, kept the boring free from water as far as the surface of the gravel-bed. A workman, having lowered a light to examine the bottom of the well, was surprised to see a lambent flame playing over the surface. On examination, this was found to arise from a disengagement of inflammable gas, which had accumulated between the lower surface of the bed of silt and the layer of gravel.

An iron pipe terminating in a funnel-shaped mouth, about one foot in diameter, was now sunk till it reached the gas stratum, and the water in the well was kept by pumping at such a level that an extra pressure of about one inch of water was maintained upon the gas below. The gas now flowed freely, at the rate of about 40 cubic inches per minute, through the upper end of the iron pipe, and when ignited, burned with a yellow flame, which could scarcely be distinguished from that of ordinary coal gas.

Two portions of the gas were carefully collected by displacement, the stream of gas being allowed to pass till the whole of the atmospheric air in the vessels was completely swept away. The connecting tubes were then carefully sealed, and the gas was afterwards analysed in the laboratory of Queen's College.

A measured volume of the gas, standing over mercury, was exposed to the action first of caustic potash, and afterwards of pyrogallic acid; the residual gas on analysis gave the following results :—

	V.	T.	B.	C.
Atmospheric air	78·7	12·2	770·9	308·8
Residual gas added ..	120·5	12·4	771·5	272·2
Oxygen added	190·0	12·1	771·8	221·8
After explosion	126·5	13·0	771·7	271·6
Carbonic acid absorbed	90·0	11·8	772·0	299·7

In this table V is the volume of the gas ; T its temperature in centigrade degrees ; B the height of the barometer in millimetres ; and C the height of the mercury in the tube in which the observations were made. From these data and the results of the previous action of the caustic potash and pyrogallic acid, it follows that the composition of the gas was :—

Marsh gas (CH_4)	83·75
Carbonic acid	2·44
Oxygen	1·06
Nitrogen	12·75

The density of the gas (air = 1) was found to be 0·661, which corresponds nearly to the foregoing composition. The gas was inodorous and contained no compound of carbon and hydrogen except marsh gas.

From this analysis it is evident that the gas formed in this subterranean sheet of water is in all respects the same as that which is produced in stagnant pools containing leaves and other vegetable matters.

REPORT OF THE COMMITTEE ON SIEMENS'S PYROMETER.*

THE following is a summary of the Report presented by the Committee :—

Four pyrometers supplied by Dr. C. W. Siemens have been examined ; they were numbered by the makers 404, 411, 414, and 445, respectively. In No. 404 the coil of platinum wire—upon the change of whose electrical resistance the indications of the instrument depend—was protected from the fire only by a wrought-iron tube closed at one end ; in Nos. 411 and 414, there was a piece of platinum foil round the coil inside the iron tube ; in No. 445, the part of the iron tube which in the other pyrometers was exposed to the fire was replaced by a tube of platinum, but this instrument, like all the rest, had a long stem formed of a wrought-iron tube, about 1¼ inch diameter, meant to project from the furnace.

The experiments consisted in repeatedly heating the pyrometers to redness in a common open fire-place (without blower), and ascertaining their electrical resistance at 10° C. before and after this treatment. The measurements were made when the part of the pyrometer containing the coil was immersed in water of known temperature, which was always nearly that of the atmosphere at the time, and the results were reduced to 10° by means of a coefficient determined by experiment. This method was preferable to attempting to bring the pyrometer always to the same temperature by means of ice, since the thermal conductivity of the wrought-iron stem made the temperature of the coil uncertain whenever there was much difference between the temperature of the atmosphere and that to which the coil was exposed. The resistances were measured by means of a Wheatstone's Bridge.

The final results were as follows:—

	Resistance at 10° C.		Change of Resistance at 10° C.	Equivalent Change of Temperature
Pyrometer.	Before Heatings.	After Heatings.		
No. 404.	9·917	10·749	+0·832	+30° C.
,, 411.	9·988	11·596	+1·608	+58° C.
,, 414.	9·920	11·089	+1·169	+43° C.
,, 445.	10·105	10·059	−0·046	−1·5° C.

Hence, it appears that pyrometers constructed like the first three, that is, with an iron tube surrounding the coil of platinum wire, cannot be relied upon to give constant

* Read before the British Association, Belfast Meeting, Section B.

results; but that No. 445, in which the use of iron to protect the coil is entirely avoided, is sufficiently constant for most industrial applications.

The experiments were made in the Physical Laboratory of University College, by Professor G. C. Foster, or under his supervision.

ON A SESQUISULPHIDE OF IRON.*
By Dr. T. L. PHIPSON, Ph.D.

THIS is a substance of a beautiful dark emerald green colour, having the composition of Fe_2S_3, produced when ferric chloride is added to a solution of sulphide of ammonium containing a certain quantity of hypochlorite of soda, or whenever a per-salt of iron, containing free chlorine, or a hypochlorite is precipitated by sulphide of ammonium. In both cases, the sulphide of ammonium must have acquired, by age, the ordinary yellow tint.

The sesquisulphide of iron forms a dark green flocculent precipitate, appearing quite black when collected on a filter and washed. Its fine green colour becomes apparent when, after drying, it is ground up with a perfectly white powder such as chalk. Its properties are rather remarkable. It is soluble, to a notable extent, in water containing ammonia, and separates therefrom as the ammonia escapes; it is even soluble in alcoholic ammonia, forming in each case a bright emerald green solution, perfectly clear, and which can be filtered. It is only slightly soluble in a mixture of sulphide of ammonium and hypochlorite solution rather diluted; neither is it more than slightly soluble in either of these substances alone. It is more easily dissolved by hot water containing free ammonia.

In hydrochloric acid, it dissolves with smart effervescence of sulphuretted hydrogen, *immediately* producing perchloride of iron, Fe_2Cl_3, in spite of the abundance of sulphuretted hydrogen present. On analysis, it is found to be a hydrated sesquisulphide of iron, answering very nearly to the formula $2Fe_2S_3 + 3HO$.

ON THE
EFFECTS OF MAGNETISATION IN CHANGING THE DIMENSIONS OF IRON AND STEEL BARS,
AND IN
INCREASING THE INTERIOR CAPACITY OF HOLLOW IRON CYLINDERS.†

By ALFRED M. MAYER, Ph.D.,
Professor of Physics in the Stevens Institute of Technology.

(Concluded from p. 106.)

The Coefficients of Elongation and of Retraction of Seven Rods of Different Species of Iron, and of Three Steel Rods of Various Degrees of Hardness.

It remains to give the determinations I have made of the coefficients of elongation and of retraction. Those measures were made on rods of circular sections, 60·1 inches long and 0·5 inch in diameter. As previously stated, the iron rods were thoroughly annealed, and the steel rods were carefully tempered. On the ends of the rods numbers were stamped, and these marks corresponded to the rods as follows:—

  1. Scrap iron.
  2. Ulster iron.
  3. Norway iron.
  4. English refined iron.
  5. Low Moor iron.
  6. Fall River iron.
  000. Steel soft.
  00. Steel hardened and drawn to blue.
  0. Steel hardened and drawn to yellow.

The method of determining the coefficients was as follows:—When the rod had attained a fixed temperature, so that the scale-reading remained constant for an hour, I recorded this scale-reading. I then passed the current from the 25-cell battery, and so soon as the new scale-reading then produced was read, I broke the circuit and obtained the corresponding scale-reading. These readings were now written in the note-book, and immediately after recording them I again made and broke the circuit, and noted the two corresponding readings of the telescope-scale. I then continued making and breaking the circuit and recording the scale divisions, until the rod began to elongate from the heat produced on demagnetisation.

The tables I here present consist of six columns, A, B, C, D, E, and F. Under A are designated the rods; B contains the elongations or retractions produced on first passing the current; C the retractions or elongations observed after the first made circuit had been broken; D the permanent elongations or retractions observed in the rod after the first circuit passed had been broken; E the elongations or retractions produced on making the second and subsequent circuits; F the elongations or retractions produced on breaking the second and subsequently formed circuits.

Table of the Elongations and Retractions of the Rods.

TABLE I.

Elongations and Retractions in Units of the Telescope-Scale.

A. Rod.	B. First Make-Circuit.	C. First Break-Circuit.	D. Permanent e or r.	E. Second Make-Circuit.	F. Second Break-Circuit.
1	1·25 e†	·75 r	·4 e†	·7 e†	·7 r†
2	1·6 e	1·2 r*	·4 e†	1·2 e	1·2 r
3	2·0 e	·9 r	1·1 e	1·4 e*	1·4 r*
4	2·5 e*	1·15 r	1·35 e*	1·15 e	1·15 r
5	1·65 e	·6 r†	1·05 e	1·0 e	1·0 r
6	1·4 e	·85 r	·55 e	·9 e	·9 r
000	·8 e*	·6 e*	1·4 e*	·25 r	·25 e
00	·25 r	·5 e	·25 e	·5 r*	·5 e*
0	·4 r†	·25 e†	·15 r†	·2 r†	·2 e†

TABLE II.

Elongations and Retractions in Fractions of an Inch.

A.	B.	C.	D.	E.	F.
1	·0001375	·0000825	·000044	·000077	·000077
2	·000176	·000132	·000044	·000132	·000132
3	·000220	·000099	·000121	·000154	·000154
4	·000275	·0001265	·0001485	·0001265	·0001265
5	·0001815	·000066	·0001155	·000110	·000110
6	·000154	·0000935	·0000605	·000099	·000099
000	·0001168	·0000876	·0002044	·0000365	·0000365
00	·0000365	·0000730	·0000365	·0000730	·0000730
0	·0000584	·0000365	·0000219	·0000292	·00002(2

TABLE III.

Coefficients of Elongations and of Retractions.

A.	B.	C.	D.	E.	F.
1	·000002283 e†	·000001377 r	·000000732 e†	·000001281 e†	·000001281 r†
2	·000002928 e	·000002196 r*	·000002196 e†	·000002196 e	·000002196 r
3	·000003660 e	·000001647 r	·000002013 e	·000002562 e*	·000002562 r*
4	·000004575 e*	·000002105 r	·000002471 e*	·000002088 e	·000002088 r
5	·000003019 e	·000001098 r†	·000001921 e	·000001830 e	·000001830 r
6	·000002562 e	·000001555 r	·000001006 e	·000001647 e	·000001647 r
000	·000001943 e*	·000001457 e*	·000003400 e*	·000000607 r	·000000607 e
00	·000000607 r	·000001212 e	·000000607 e	·000001212 r*	·000001212 e*
0	·000000972 r†	·000000607 e†	0·00000364 r†	·000000486 r†	·000000486 e†

After the quantities given in the columns, I have written e to designate the *elongation* of the rod, and r to indicate its *retraction*.

I have given the measures in three tables. Table I. contains the elongations and retractions in the actual scale units. It is here to be remembered that one division of the scale equals 0·00011 of an inch for the experiments on rods No. 1 to No. 6, inclusive; while for the remaining rods, 000, 00, and 0, one division of the scale equals

* Maximum.   † Minimum.

0·000146 of an inch. Table II. gives the elongations and retractions of Table I. expressed in fractions of the inch of "Troughton's scale."*

Table III. contains the coefficients calculated from the numbers given in Table II.

Certain numbers of the tables are followed by * or by †; * indicates the maximum effect observed in the iron, or in the steel rods, corresponding to the phase of experiment given in the heading of the columns of Table I., or as subsequently designated by A, B, C, D, &c. An examination of the tables shows that the maxima and minima effects, in the case of the iron rods, are very irregularly distributed. Thus, corresponding to the "first make-circuit," we find that rod No. 4 gives the maximum, while rod No. 1 the minimum. On the "first break-circuit," rod No. 2 is the maximum, while rod No. 5 is the minimum. For the "permanent elongation," rod No. 4 is the maximum, and rods No. 1 and 2 are the minima. In the two columns corresponding to "second make-circuit" and "second break-circuit," we see that rod No. 3 gives the maximum effect observed, while rod No. 1 gives the minimum.

The Phenomena of Elongation and Retraction observed in Rods of Steel.

The phenomena observed in the magnetisation and demagnetisation of the rods of steel have not been referred to. Here we have presented to us remarkable results. On first passing the current around rod ooo, of soft steel, it elongated 0·8 of a scale-division, behaving like a rod of soft iron; but, on breaking the circuit, to my astonishment, it again *elongated* 0·6 of a div., thus leaving this rod with a permanent elongation of 1·4 divs.; and this elongation exceeds the permanent elongation given to any of the soft iron rods when similarly experimented on. On passing the current around the rod, *for the second time,* the soft steel rod again did not act like a rod of iron, for it *retracted* 0·25 of a div. instead of *elongating*, as did the rods of iron in like circumstances; and on breaking this circuit the rod *elongated* 0·25 of a div., instead of retracting; again exhibiting a phenomenon the reverse of those observed in the rods of iron; and it is here important to remark, that *all* of the steel rods behaved in the same manner on the making and breaking of the second and subsequently formed circuits.

The results just described differ from those obtained by Dr. Joule. Referring to his memoir (*Phil. Mag.*, vol. xxx., p. 85), we find that experiments on a rod of soft steel, one yard long and a quarter of an inch in diameter, showed that the rod elongated on first passing the current; but on breaking this circuit the rod *retracted*, while in my experiments the rod again *elongated* on breaking this circuit. Indeed, the experiments of Dr. Joule indicate that a rod of soft steel behaves like one of iron, except that the elongations and retractions are of less extent than in the case of an iron rod. It is important, however, to observe that Dr. Joule did not, in his first experiment on this rod, pass around it a current sufficient to "saturate" it, but gradually increased the intensity of the current in successive experiments; and it is to be remarked that, as the intensity of the current increased, the retractions and elongations came nearer and nearer to equality, but in no instance did he observe a *retraction* on passing a current and an *elongation* on its cessation.

In his subsequent experiments, Dr. Joule worked on a steel rod of the same dimensions as that used in his former experiment, but it was "hardened to a certain extent throughout its whole length, but not to such a degree as entirely to resist the action of the file." On *first* passing

the current, and also in subsequently passing the current with successively increased intensities, he obtained results similar to those I observed in the rod of soft steel, but with this rod also he never observed a *retraction* on making a circuit, and an *elongation* on breaking it. The fact that so eminent an investigator as Dr. Joule obtained, on *first* passing a current around a bar of soft steel, results similar to those obtained by me with my bar of soft steel, leads me to suspect that the rod I experimented on may have retained some degree of "hardness" after it had been annealed; but even this fact granted, does not explain why *all* the steel rods I experimented on gave *retractions* on passing the current a *second* time after they had been "saturated" during the *first* passage of the current.

Examining the results of my experiments on rod oo, of hard steel "drawn to blue," we see that the phenomena are exactly the reverse of those occurring in rods of iron in the same circumstances, except in this one particular, viz., that after breaking the first made circuit the rod is permanently *elongated*; and this result agrees with all of those obtained by Dr. Joule.

The experiments on rod o, of hard steel "drawn to yellow," are noteworthy. On making the *first* circuit, this rod *retracted* 0·4 of a div., and on breaking this circuit the rod elongated, but only 0·25 of a scale division, thus leaving the rod permanently *retracted* 0·15 of a div.; so that this rod of hard steel, which after the experiment remained a powerful magnet, is *shorter* than it was before it was magnetised. On passing the second current around this rod, it, like the two preceding rods, *retracted* 0·2 of a div., and on breaking this circuit it elongated by the same quantity, so that, after the second and subsequent passages of the voltaic current, it persisted in the retraction it received after the first made circuit was broken.

The experiments I have just given on rod o differ in every particular from any obtained by Dr. Joule on rods which were *not subjected to tractile strain.* I cannot but regret that this eminent physicist did not experiment on rods of very hard steel freed, as far as possible, from all strains; for then my experiments would have been strictly comparable with his. The experiments which Dr. Joule made on rods of hard steel (except those I have already quoted) were conducted on rods subject to tractions going from 80 lbs. up to 1030 lbs., while my experiments were made on rods so supported by brass springs that only a fraction of their weight was supported by the V's on which their ends rested.

Referring to Dr. Joule's experiments on a "soft steel wire, one foot long, a quarter of an inch in diameter, tension 80 lbs.," we find that this rod behaved like one of soft iron, free of strain, with currents deflecting his galvanometer 34° 40' up to 56° 30'; but with currents below 34° 40', no action whatever was observed to take place in the rod, except its magnetisation; but when the same rod was subjected to a tension of 462 lbs., and a current of 60° 15', it behaved like my horizontally suspended steel rod oo; that is, it retracted on making the circuit, but it elongated more than it had previously retracted when this circuit was broken. With a tension of 1680 lbs., the rod retracted and elongated by equal amounts on making and breaking the circuits. In Dr. Joule's experiments on a "hardened steel wire," one foot long, a quarter of an inch in diameter, tension 80 lbs., he observed no effect until the current reached an intensity of 45° 40'; then this rod also elongated and retracted by equal quantities on making and breaking the circuits. With a tension of 408 lbs. and of 1030 lbs. this rod behaved in the same manner, but the elongations and retractions did not begin to show themselves with the respective tensions until the currents had respectively reached the intensities of 60° 20' and 48° 33'. Summing up these results, Dr. Joule states:—"From the above experiments, we find that the induction of permanent magnetism produces no sensible effect on the length of a bar of perfectly hardened steel, and that the temporary shortening effect of the coil is proportional to

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* "Two copies of the British standard, viz., a bronze standard, No. 11, and a malleable iron standard, No. 57, have been presented by the British Government to the United States. A series of careful comparisons—made in 1856, by Mr. Saxton, under the direction of Dr. Bache—of the British bronze standard, No. 11, with the Troughton scale of 82 inches, showed that *the British bronze standard yard is shorter than the American yard by* 0·00087 *inch.* So that in very exact measures with the yard-unit, it is necessary to state whether the standard is of England or of the English feet."—"Lecture Notes on Physics," by A. M. Mayer, p. 12. New York: Van Nostrand. 1868.

the magnetism multiplied by the current traversing the coil. The shortening effect does not in this case sensibly increase with the increase of the tension." We have no reason to doubt the truth of this statement when applied to rods subject to tension, but my experiments show that when the rod ooo, of soft steel, and the rod ɢo, of hard steel " drawn to blue," were not subject to such strains, and indeed freed, as far as possible, from all strain, they were *permanently elongated* after they had received their permanent magnetism ; and also, that the rod o, of hard steel " drawn to yellow," had a *permanent retraction* given to it with its permanent magnetic change.

My experiments have been made with such conscientiousness, that at present I am not able to doubt the reality of these effects; but they should be repeated on fresh bars, and this I intend to do at some future day.

It is important that I should here call attention to the fact that the coefficients I have given in the appended tables are derived from measures on only *one* rod of each species of metal ; and it may be that a considerable range in the elongations and retractions may be found in rods made of the same kind of iron or of steel. I hope to be able to present a new series of determinations of these constants, to be made with the apparatus already described, which employs the displacements of Newton's rings as a means of measuring the changes in the longitudinal and transverse dimensions of the rods.

When it is considered that the greatest motions, which have been the objects of my study, have their existence in the space of $\frac{8}{100000}$ths of an inch, while the smallest space within the limits of visibility of the most powerful microscope, being only $\frac{3}{200000}$ths (or 0·000005) of an inch, and furthermore, when it is known that the last-mentioned quantity equals the change in length of one of the rods caused by a variation of temperature of only $\frac{7}{1000}$ths of a degree C., the difficulties I have conscientiously met and surmounted in this delicate research become manifest ; but the very knowledge of those difficulties has tempered with modesty the confidence I feel in my work, and I will gladly accept any correction my measurements may receive from more experienced hands.

NOTES OF WORK
BY STUDENTS OF PRACTICAL CHEMISTRY
IN THE LABORATORY OF THE
UNIVERSITY OF VIRGINIA.
(No. III.)

Communicated by J. W. MALLET,
Professor of General and Applied Chemistry in the University.

(Concluded from page 119.)

(2). *Analysis of Allanite from a New Virginia Locality.* By Mr. J. ALSTON CABELL.

SEVERAL pieces of this mineral were brought me some months ago from a point in Amherst County in this State about fifteen miles west of Amherst Courthouse. The largest piece weighing a pound or two, and said to have been broken from a much larger mass, presented the appearance of a rough, imperfect fragment of a crystal, three or four inches long and wide, and an inch or inch and a half thick, showing imperfect external and cleavage planes. There was little adhering matrix, but such as remained consisted of decomposing felspar and a little quartz. The colour was black, with greasy and sub-resinous lustre on surfaces of fracture. Hardness between 5 and 6. Sp. gr.=3·83. Easily decomposed by boiling hydrochloric acid of moderate strength.

Mr. Cabell obtained the following results of analysis, using considerable quantities of material for the detection and determination of the rarer earths, separating the cerium metals (after precipitation from the general solution as oxalates) by nitric acid and lead dioxide, as recommended by Dr. Wolcott Gibbs, and determining the water by direct weighing.

Silica				31·23
Alumina				16·45
Ferric oxide				3·49
Ferrous oxide				13·67
Cerous oxide				11·24
Lanthanum oxide }				
Didymium oxide }			9·90
Yttria				1·65
Glucina				0·24
Lime				8·69
Magnesia				0·22
Water				2·28
				———
				99·06

If the water be supposed non-essential, and all the basic constituents except alumina and ferric oxide be taken as monoxides, these numbers lead to a fair approach to the general formula usually assumed for allanite, viz,—the same as that for garnet—

$$\left. \begin{array}{c} R_3'' \\ R_2''' \end{array} \right\} Si_3O_{12},$$
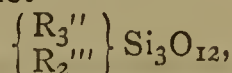
the atomic proportions of $SiO_2 : RO : R_2O_3$ being $1 : 1·11 : 0·35$ or $3 : 3·33 : 1·05$ instead of $3 : 1 : 3$ as required by this formula.[*]

It is worthy of notice, however, that if the cerium metals and yttrium be viewed as tri-atomic and their atomic weights altered accordingly, as lately urged by Cleve,[†] the analysis accords nearly as well with the regular formula of epidote, the species to which on crystallographic grounds allanite seems most closely related. Thus the epidote formula—

$$\left. \begin{array}{c} R_6'' \\ R_8''' \end{array} \right\} Si_9O_{36}—$$
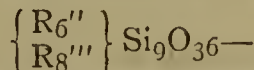
requires $SiO_2 : RO : R_2O_3 = 9 : 6 : 4$, while the above analysis gives the ratio $1 : 0·69 : 0·49$ or $9 : 6·21 : 4·41$.

(3). *Examination for Indium of Smithsonite from South-Western Virginia and Eastern Tennessee.* By Mr. JOHN A. TANNER, of Linchburg, Va.

ALL the published statements, so far as I have seen them, referring to the occurrence of indium in nature speak of it as associated with zinc in *blende.*[‡] Hence I proposed to Mr. Tanner to test for this rare metal the mixed carbonate and silicate of zinc worked in Wythe Co., Va., and Leadvale, Tenn., for some masses of which of considerable size I had been indebted to Mr. C. R. Boyd of Wytheville and Mr. H. S. Noble, of the Mercer Zinc Works. The ore consisted in each mainly of Smithsonite, but with no small admixture of calamine, and was partly compact, hard and sub-crystalline in structure, partly friable and earthy. One pound of the ore from each of the localities in question was coarsely pulverised and decomposed by hydrochloric acid, silica separated by evaporation to dryness and re-solution, a piece of metallic zinc known to be pure, digested in the liquid as long as any deposit formed (about six days), the precipitate scraped off, rapidly filtered and washed. This precipitate was then dissolved in dilute nitric acid, lead thrown down by sulphuric acid, and filtered off, the filtrate evaporated to drive off surplus nitric acid, slightly diluted and precipitated by sulphuretted hydrogen (which threw down cadmium and a trace of copper from each of the solutions). The filtrate was boiled, heated with a little potassium chlorate, precipitated with ammonia in excess, the precipitate re-dissolved in hydrochloric acid, and again precipitated with excess of ammonia. This precipitate was washed, digested with warm, dilute acetic acid, and sulphuretted hydrogen passed through the solution to saturation. The precipi-

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[*] In the calculation it has been assumed that lanthanum and didymium are present in equal amount, the mean of the two atomic weights being used.

[†] *Bull. de la Soc. Chim. de Paris*, 5 Mars, 1874, p. 196; 20 Mars, 1874, p. 246; 20 Avril, 1874, p. 344.

[‡] Hoppe-Seyler reports indium with zinc (in what state of combination?) in wolfram. In the *American Chemist* for January 1873, p. 242, are recorded by H. B. Cornwall, the results of testing several American blendes for In.

tate now thrown down by H_2S was filtered, well washed, warmed with a drop or two of nitro-hydrochloric acid, the liquid evaporated almost to dryness and tested before the spectroscope. The result was that the residue so obtained from a pound of the Virginia ore gave but a very faint and doubtful indication of the presence of indium, but in the case of the Tennessee ore the principal blue line (*a*) was unmistakably seen, the test being repeated several times. The quantity of the rare metal present was no doubt excessively minute.

The first sulphuretted hydrogen precipitate, and the filtrate from the second, were examined before the spectroscope, but afforded no further trace of indium.

(4). *Experiments to Determine the Effect of the Carbon contained in Iron-Wire upon the use of the latter in Standardising a Solution of Potassium Permanganate.* By Mr. J. R. McD. IRBY.

IN connection with the extensive use of potassium permangananate in volumetric analysis, perhaps the most common method of determining the strength of the solution of this salt when accurate results are desired, consists in dissolving in dilute sulphuric acid a known weight of fine iron-wire, and observing how much of the permanganate this iron solution will decolourise. This is specially recommended by Fresenius,[*] who draws attention to the fact that the best iron-wire does not represent chemically pure iron, but contains on an average 0·3 per cent of foreign matter, and hence advises that the amount of wire actually weighed shall be multiplied by 0·997 in calculating the strength of the solution. This correction of course involves the assumption that the impurities of the iron simply diminish the amount of this metal really present, and have no other influence upon the process. It seemed last autumn to have been overlooked that the chief impurity in wrought-iron is carbon, and that when separated in a state of extremely fine subdivision, this might itself quite possibly exert a reducing action upon the permanganate, and if so that (taking into account the low atomic weight of carbon as compared with iron) the correction required might be additive instead of subtractive and to a greater amount than the actual weight of foreign matter in the iron. Mr. Irby proposed to himself to examine this point, and had nearly completed the experiments, when attention was drawn to the matter by Berthelot,[†] whose paper of course divests the subject of novelty, but as he has not recorded any actual results of quantitative experiment, it seems well to publish some of the figures obtained here, omitting others which simply went to confirm the general conclusion.

In one instance a solution of permanganate was prepared, which, standardised by pure oxalic acid, was found of such a strength that 0·1 grm. of Fe = 18·15 c. c. of solution. 1·0407 grms. of bright, fine, piano-forte wire was dissolved in dilute sulphuric acid in a small flask. The solution was well mixed, and allowed to stand until quite clear, the foreign matter, consisting of some little black flocks, having settled to the bottom. The flask with its contents was weighed, and three successive portions of the solution were decanted off clear of carbon into other flasks, the loss of weight being each time ascertained—the remaining portion of solution contained all the carbon of the whole. All proper precautions were taken to prevent oxidation by contact with the air. The amount of permanganate solution decolourised by each of the four portions was now determined.

The first portion of iron solution of 13·125 grms. took 52·05 c.c. of permanganate.
The second portion of iron solution of 12·887 grms. took 51·20 c.c. of permanganate.
The third portion of iron solution of 11·618 grms. took 46·15 c.c. of permanganate.

* *Anleit. z. quant. Chem. Anal*, 5th Aufl., S.S. 230—234.
† *Bull. de la Soc. Chim. de Paris*, 20 Janv., 1874. p. 58.

Hence—
From the first portion of solution 0·1 grm. of Fe = 18·20 c.c. of permanganate.
From the second portion of solution 0·1 grm. of Fe = 18·25 c.c. of permanganate.
From the third portion of solution 0·1 grm. of Fe = 18·25 c.c. of permanganate.
Agreeing well with the determination by oxalic acid.

The fourth portion of iron solution (with suspended carbon) of 10·032 grms. took 43·70 c. c. of permanganate, but calculating from the mean of the preceding figures, this should have taken but 39·83 c.c. On reduction of ferrous sulphate (by means of zinc) and re-addition of permanganate it actually took 40 c.c. Thus the carbon of 1·0407 grms. of iron-wire reduced 3·7 c.c. of permanganate, and so did the work of 0·0203 grm. of Fe, or introduced an error equal to 1·95 per cent of the quantity weighed.

In another experiment, an attempt was made to isolate the carbonaceous residue, and determine the extent of its sole action upon the permanganate. 7·2194 grms. of iron wire was dissolved, the black flocculent residue filtered off, washed as carefully as possible, and treated with permanganate solution of same strength as above. 12·5 c.c. were decolourised = 0·0687 grm. of Fe = 0·95 per cent of the quantity weighed. In this case it is doubtful whether all the residue left by the acid was collected unoxidised in the first instance, and it was observed that the oxidation by the permanganate was incomplete, some black specks remaining floating on the liquid.

The above figures sufficiently prove that an error of from 1 to 2 per cent may be committed in standardising potassium permanganate by means of iron wire assumed to represent pure iron, and that the error is increased, instead of diminished, by assuming such wire to represent *less* than its weight of Fe.

(5). *Analysis of a Curious Specimen of Iron produced in connection with the Working of Heaton's Steel Patent.* By Mr. J. ALSTON CABELL.

The iron in question was from the sides of the reheating furnace used in preparing for the tilt-hammer the steel obtained by Heaton's process (action of Chili saltpetre upon fused cast-iron).

It was almost as white and lustrous as silver, showed little tendency to rust, and presented a remarkable appearance as of crystallisation, the mass being made up of granules ranging from an eighth to a quarter of an inch in diameter, on which faces suggesting those of the octahedron and dodecahedron were everywhere observable.

These faces, however, were nearly all of them more or less curved and contorted, and more careful examination seemed to show that the structure was in reality pseudo-crystalline only, as in the well-known cases of basalt, starch, &c. The mass would not bear much hammering without crumbling apart, the granules in question parting from one another without much difficulty, but each single granule proved to be tough and malleable, admitting of being flattened out easily enough upon the anvil. The iron could, moreover, be easily filed and sawed, and was not materially hardened by heating red-hot and suddenly cooling in water. It was, therefore, essentially wrought-iron, sp. gr. = 7·86. After a careful qualitative analysis, Mr. Cabell obtained the following quantitative results :—

Carbon..	1·121
Silicon	0·024
Sulphur	0·037
Phosphorus..	0·436
Iron (by difference)	98·382
	100·000

The large amounts of carbon and phosphorus are quite remarkable in connection with the malleability and incapability of being hardened of the metal, and its high specific gravity and curious structural character still further render it worthy of notice.

University of Virginia, July 20, 1874.

NOTICES OF BOOKS.

The Sanitary Condition of Oxfordshire. By GILBERT W. CHILD. London : Longmans, Green, and Co.

THIS report is one of the most valuable first-fruits of recent sanitary legislation. It throws a clear, but far from " rose-coloured " light upon the condition of average rural districts, villages, and small towns. Many statements which the British public hoped were exaggerated, and sensational, are here confirmed in the plainest and most matter-of-fact manner. Concerning the water we are told : —" It is really the exception to find in country districts a water supply which is at once plentiful and wholesome, and even tolerably accessible to the people. In a large number of towns and villages the drinking-water in use is in the very foulest condition." All this we can fully confirm from our own observation. We fear that the drinking-waters of the fen districts, and the eastern counties generally, are even worse than those which our author has met with in his district.

The cottages, from a sanitary point of view, are even worse. " I have entered many," says Mr. Child, " almost completely black, reeking of smoke and filth, damp, clammy, and noisome. I have constant cases brought before me in which six, eight, or ten people are sleeping in one such room as I have now faintly described."

The observations on the propagation of fever, and its evident close causal connection with nuisances, are very valuable. We find a curious instance where two petroleum barrels had been buried in the earth, and where a chain of wells extending over a distance of 189 yards were in consequence tainted with the nauseous flavour. This is an important case as showing the distance to which pollutions may penetrate through the soil.

As regards the disposal of excreta and domestic refuse, the author recommends, in preference both to cesspools, dry closets, and complete water sewage, the Milan system of water-tight cesspools, emptied by atmospheric pressure.

He complains that this system is too often condemned on account of a clumsy imitation of it which exists in Paris. In Milan it is described as being completely successful, and it has been recently introduced into Florence. For the weighty objections to the dry closet system and to complete water sewage as carried out in London we must refer our readers to the work itself.

We regret that space does not permit us to enter upon a more detailed summary of the contents of this report, and we heartily commend it to the attention of members of the Legislature, magistrates, land-owners, as well as of the medical and chemical professions.

CORRESPONDENCE.

MANUFACTURE OF ARCHIL AND CUDBEAR.

To the Editor of the Chemical News.

SIR,—I am a working man. I have looked in a great many works on chemistry for information on the manufacture of archil and cudbear, but in all the works out there is no real practical information on the subject. I will write this short sketch as well as I can for your information, so that, if ever you write a work on the subject, you can inform your readers of the real practical part of the manufacture, as well as the theoretical and chemical changes. You would confer a great boon on the masters in the trade, as well as the workmen, if ever you brought a work out on the subject. I believe one great obstacle in the way of authors getting information on the practical part is because the manufacturers keep it as secret as possible. As an instance, at the place where I work they will employ no one that has worked in any chemical trade; and when they do employ anyone, there is a deal of cross-

questioning about where they have worked, and whether they can read and write, and if they can it is ten to one whether they employ him, because they want the men as ignorant as possible—they want them to do the bidding, but not to make any mistakes, and not to inquire into things. Then they will let any of us stop while we are old men, which is very common in chemical works. That is the main cause of so much secrecy.

Archil Liquor.—To make liquid, put 300 lbs. of Zanzibar orchella-weed into a cistern, about 120 gallons of ammonia at 3° strong on the top of it ; steep day and a night ; run it out of the cistern into pans heated with steam pipes underneath, the size of which is 6 yards by 4, 1 foot deep, with a lid on the top. Take the lid off once a day, about five minutes agitate it a little, and then it will be ready in about six weeks for storing up or dyeing with. Worth about 3d. per lb.

Paste Archil.—To make paste archil, the weed is ground a little ; it is worked in pans heated with steam-pipes underneath (size, about 4½ feet long, 2¼ feet wide, 2 feet deep), with an iron lid to fit on to keep the ammonia gas in. In these pans we put 50 lbs. of weed, 100 of ammonia 8° strong. It is turned over with a shovel twice a day (morning and night), and it will be ready for coming off in about eight days ; then it is mixed with 20 lbs. of sulphuric acid and 200 of common salt. That is for four of these pans ; contents of all four put into a cistern, the acid, salt, and water mixed together. Worth about 2½d. per pound.

Cudbear.—To make cudbear is just the same as paste. Instead of mixing with salt, acid, and water, it is dried on an iron plate about 10 yards square, with steam heating it underneath. When it is dried, it is ground to a powder ; then it is cudbear of commerce. Worth about 8d. per lb.

Blue Archil.—To make blue archil, put 100 lbs. of weed, 300 of ammonia 6° strong ; work cold ; turn over twice a week. It will be ready in about ten weeks. That is blue archil of commerce.—I am, &c.,

A LEEDS WORKMAN.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 4, July 27, 1874.

Action of Rays of Different Refrangibility upon the Iodide and Bromide of Silver. Influence of Colouring Matters.—E. Becquerel.—It is known that the physical condition of bodies susceptible to the action of light, as well as the presence of matters affecting the chemical effects produced, may not only augment their sensitiveness, but may even modify the extent of the part of the luminous spectrum in which they are acted on. If iodide of silver is prepared as in Daguerre's process, and then exposed to the solar spectrum without having been previously acted on by light, it is only sensitive from the blue to the extremity of the ultra-violet. But if iodide of silver has been previously insolated for a short time before the action of the spectrum, it is not only sensitive within the limits above mentioned, but also between the red and the blue. If iodide of silver is obtained by double decomposition, and fixed upon paper, or incorporated with collodion or gelatine, the effects may vary according to circumstances. If precipitated in an isolated pure state it is almost inactive. If fixed upon paper, and in presence of an excess of nitrate of silver, it becomes very sensitive, presenting two maximum points of action, one in the yellow, and the other in the blue-violet. The bromide and chloride of silver behave in a similar manner. If iodide of silver is incorporated with

collodion, so as to form the sensitive surfaces commonly used in photography, and if, either with or without previous insolation, it is exposed while moist to the action of the solar spectrum for a short time, and the image obtained is developed by means of protosulphate of iron, or pyrogallic acid, we observe in general merely an action extending from the ultra-violet to between F and G, with a maximum of action between G and H, but nearer G. Chloride of silver behaves the same. The bromide gives in these conditions a longer spectrum, extending to the green. With dry collodion the effects are the same as with paper in the conditions indicated above. Vogel has observed that if bromised or iodised collodion is mixed with various colouring matters, the extent of the sensitive zone is changed, and the surface may become immediately affected by the red, yellow, or green rays, according to the nature of the substance. Thus the surface becomes sensitive to rays which, in the absence of these colouring matters, would be inert. Coralline and aniline-green give very marked results. With coralline the chemical spectrum extends to the orange, with a maximum point in the green between D and E. With chlorophyll in very small proportion, the sensitive region extends from the ultra-violet to beyond E in the green.

Report on Methods for Protecting Vines from the Phylloxera.—MM. Milne-Edwards, Duchartre, &c.

Researches on Explosive Bodies.—MM. Noble and F. A. Abel.—An account of these researches has already appeared in English.

Amount of Water Consumed by Wheat during its Growth.—M. Marié-Davy.—An account of experiments showing the quantity of water required by wheat planted in different soils, and treated with different manures.

Production, in the same Medium and at the same Temperature, of the Octahedral and Prismatic Varieties of Sulphur.—M. D. Gernez.—It is generally assumed that the polymorphic varieties of bodies can only take their origin under different circumstances of medium or of temperature. The author has succeeded in producing at will, in the same liquid and in the same temperature, either the one or the other of the two forms of sulphur. He places in a tube closed at one end either variety of sulphur, e.g., octahedral crystals, and dissolves them in toluen or benzin at a temperature considerably below 80°, and thus prepares a supersaturated solution. When this is cooled down to 15° without crystallising, he introduces the end of a stiff wire carrying an octahedral crystal. Immediately crystals, all octahedral, form, and slowly increase. If a prismatic crystal is introduced, prisms are formed in the same manner.

Action of Ether on Binoxide of Copper.—Aug. Gueront.—When anhydrous ether is heated in a closed vessel to about 280° with binoxide of copper obtained by precipitation, and dried *in vacuo* over sulphuric acid, the oxide becomes a yellow mass. On treatment with dilute hydrochloric acid this mass is resolved into metallic copper, and a small quantity of hydrated protoxide of copper. The liquid products are, besides ether, aldehyd and acetic acid. If the black oxide of copper still contains moisture, the result is anhydrous protoxide, the colour of which is slightly modified, and a small quantity of metallic copper. Acetic acid is produced in this case in a smaller quantity. Black oxide of copper, prepared in the dry way, is not reduced by ether, whether water be present or absent.

On Isoterebenthen.—M. J. Ribau.—This paper is not adapted for abstraction.

Splitting-Up of the Fibrin of Blood, and the Production of a Substance Analogous to Ordinary Albumen.—A. Gautier.—A solution of fibrin in aqueous chloride of sodium is freed from salt by dialysis, and rapidly concentrated by distillation in a vacuum at a temperature of 45°. A neutral solution is thus obtained, possessing most of the properties of ordinary albumen.

Antiseptic Property of Heavy Coal-Oil.—M. L. Dusart.—An account of experiments on the action of " heavy oils " upon putrescent matter.

New Process for the Manufacture of Stuccos, or Cements known as Aluminous.—M. Ed. Landrin.—This paper does not admit of useful abstraction.

Decomposition of Albumenoid Matters in a Vacuum.—MM. Gréhant and E. Modrizejewski.—Analyses of the gases given off by 100 c.c. of dog's blood, previously freed from fibrin, and kept for four days in a vacuum at the temperature of 45° to 52°.

Phosphates of Lime of Ciply, in Belgium.—M. Nivoit.—The deposit lies near Mons, in the upper part of the chalk. The nodules have the following composition :—

Water ... ... ⎫	
Organic matter ... ... ⎬	25·55
Carbonic acid ... ... ⎭	
Sand and clay	1·30
Phosphoric acid	20·35
Sulphuric acid	0·12
Chlorine	0·25
Fluorine	0·18
Lime	51·60
Oxide of iron	0·90
	100·13

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 11, July 13, 1874.

Identity of Phenyl-Carbamidol and Diphenyl-Urea.—W. Lossen.—The author shows that the products arising on the formation and decomposition of both bodies are identical, and that both may be expressed by the same formula.

Tetra-Phenyl-Guanidin and Diphenyl-Cyanamid.—W. Weith.—This paper contains an account of the action of chloride of cyanogen upon diphenylamin ; of tetra-phenyl-guanidin and its salts ; its behaviour with hydrate of potassa, and with aqueous hydrochloric acid ; the constitution of diphenyl-cyanamid ; its behaviour with potassa, with aniline, and diphenylamin ; and the formation of polymeric diphenyl-cyanamid.

Contributions to the Establishment of the " Position Formulæ " of the Allyl Compounds, and of Acrylic Acid.—E. Linnemann.—From this lengthy treatise we extract the following propositions :—Acrylic acid, even at an average atmospheric temperature, takes up nascent hydrogen from acid solutions, and is thus converted into propionic acid by all known ordinary hydrogenising agents. [Caspary and Tollens maintain that acrylic acid is not convertible into propionic acid by zinc and sulphuric acid.] Allyl-alcohol, if treated at elevated temperatures with zinc and sulphuric acid, takes up hydrogen, and becomes normal propylic alcohol. [This, as the author points out, is again an opposite result to that reached by Tollens.] Allylic alcohol takes up nascent hydrogen from an alkaline solution only with great difficulty.

New Dinitro-Benzol.——A. Rinne and Th. Zincke.—This compound contains 42·85 per cent of carbon, and 2·38 per cent of hydrogen. Its formula is $C_6H_4(NO_2)_2$.

Behaviour of Alcoholic Yeast in Media free from Oxygen Gas.—Moritz Traube.—The results of the experiments described are—(1) Yeast germs do not develope themselves without free oxygen, even in media favourable to their growth, such as grape-juice. (2) Developed yeast, on the other hand, as Pasteur correctly maintains, can increase in suitable media, in the absence of every trace of oxygen. (3) Pasteur's statement that yeast, if air is excluded, can obtain the oxygen necessary to its growth from sugar is incorrect, for the increase ceases whilst the greater part of the sugar is still undecomposed. The accompanying albumenoid bodies are used for its growth

by yeast secluded from air. (4) In a solution of pure sugar yeast occasions alcoholic fermentation in the absence of every trace of oxygen, and without increasing. The assertion of Pasteur that the fermentation of sugar is connected with the process of organisation of the yeast is incorrect. (5) Whilst grapes, on exclusion of air, produce alcohol from their sugar, even if much bruised, this property is no longer possessed by the expressed juice. (6) It does not hence necessarily follow that alcoholic fermentation is a vital process, depending on the activity of the living cells.

Constitution of Chrysin and Tecto-Chrysin.— J. Piccard.—The author describes the reactions of the above-named bodies, and gives an account of anhydrous phloro-glucinic acid.

Communications from the Laboratory of Würzburg University.— J. Wislicenus.—Further researches on diaceto-succinester, aceto-succinester, aceto-malonester, and allyl-acetester.

Further Communications on the Compounds of Iodine and Thallium.—Th. Knösel.—The protiodide of thallium, TlI, can be obtained in a red, a green, or a yellow state. The yellow modification passes rapidly into the green on exposure to direct sunlight.

Action of Ethyl-Oxalic Chloride upon Sulph-urea. —B. Peitzsch.—Hydrochloric acid is given off along with carbonic oxide, and a tough orange mass remains, which, after re-crystallisation from alcohol and treatment with animal charcoal, yielded colourless rhombic prisms, $C_4O_2SN_2H_8$.

Lecture Experiment on Osmose.—Arnold Heintz.— This paper requires the accompanying illustration.

Researches on the Volume-Constitution of Solid Bodies.—H. Schröder.—Not adapted for abstraction.

New Sulphuretted Derivative of Hydrocyanic Acid. —O. Wallach.—The new substance, chrysean, consists of :—

Carbon	30·20
Hydrogen	3·14
Nitrogen	26·41
Sulphur	40·24
	99·99

corresponding to the formula $C_4H_5N_3S_2$. Chrysean is a solid body, resembling Mosaic gold in appearance, sparingly soluble in cold water, more readily in hot water, alcohol, ether, acids, and alkalies, from which it crystallises unchanged. A chip of firwood dipped in the sulphuric or hydrochloric solution is coloured red.

Resorcin from Dinitro-Benzol.—C. Wurster and E. Nölting.—The authors have obtained resorcin from bromnitro-benzol.

Test for Narcein.—A. Vogel.—If narcein is placed in a watch-glass, and covered with chlorine water, and if a few drops of ammonia are added with constant stirring, a deep blood-red colour appears, which does not disappear either on the addition of an excess of ammonia or on constant stirring.

The Three Isomeric Compounds, C_2H_4BrI.—H. Lagermarck.—Not suitable for abstraction.

Researches on the Substitution of the Nitro Fatty Bodies.—J. Tschermak.—Not suitable for abstraction.

Communications from the Laboratory of the London Institution.—H. E. Armstrong.—Notices on the behaviour of the nitrophenol which melts at 45° with bromine and chlorine ; on the behaviour of the same nitrophenol with sulphuric acid; an the position of the sulpho group in phenol-para-sulphonic acid; and on the decomposition of dichlor-nitrophenol by heat.

A Fifth Oxy-Toluylic Acid.—F. Fittica.—This fifth acid has the same composition as the former four. It is obtained from mono-nitro-toluylic acid, melting at 190°. It does not become violet with chloride of iron.

Action of Chloroform upon Sodium Acetic Ether,— A. Oppenheim and S. Pfaff.—Not suitable for abstraction.

The Phenomena of Neutralisation, and the Basicity of Arsenious Acid in an Aqueous Solution.—Julius Thomsen.—Arsenious acid in aqueous solution is a feeble bibasic acid, and its salts, with a large amount of base, must be regarded as basic salts.

Diphenylated Guanidin.—W. Weith and B. Schrœder.

Diphenyl Guanidin.—A. W. Hofmann.—Both these interesting papers are unsuitable for abstraction.

Bulletin de la Societe Chimique de Paris, tome xxi., No. 11, June 5, 1874.

Purification of Cerebrine.—Edme Bourgoin.—The cerebrine is extracted in the ordinary manner by means of alcohol and ether. In this state it contains a small quantity of phosphorus. To purify it it is treated with a sufficient quantity of alcohol at 90°, raising the temperature gradually and slowly. Cerebrine dissolves below the boiling-point, whilst a viscid phosphuretted matter is left adhering to the bottom of the vessel. The clear liquor is decanted, when the cerebrine is deposited on cooling. As thus obtained it is free from phosphorus. With Gobley, the author does not consider Liebreich's protagon a definite body, but a mixture.

On Cohesion.—M. West.—A physical paper.

Manganic Acid.—T. L. Phipson.—With reference to a paper by M. Terreil, the author points out that in 1860 he stated reasons for regarding the permanganate of potash as a bimanganate analogous to bichromate and bisulphate, and that manganese forms only one acid.

Thermic Researches on Hydrogen.—P. A. Favre.— The author maintains that in the hydride of palladium the hydrogen is in an active state, as are certain elements in explosive bodies.

Reclamation Respecting a Paper by M. J. Thomsen. —P. A. Favre.—A controversial note as to priority.

Influence of Nitrogen in Textile Fibres on the Direct Fixation of the Aniline Colours.—E. Jacquemin. The author finds that cellulose, on being converted into gun-cotton (nitro-cellulose), becomes capable of taking magenta, aniline blue, &c., without the intervention of a mordant, just like silk or wool. He does not, however, consider that this fact can have any practical value in the tinctorial arts. It must not be supposed that the presence of nitrogen in an organic body necessarily implies the power of combining with artificial colours. Thus oxamide refuses to take up magenta even at a temperature of 80° C.

Correspondence from St. Petersburg ; May, 1, Old Style.—W. Louguinine.—Transactions of the Russian Chemical Society at its session, Feb. 7, 1874.

Determination of Chlorine in Animal and Vegetable Bodies.—Behaghel von Adlersknon.—To prevent a loss of chlorine in the incineration of organic matter either baryta or carbonate of soda is added. The amount found is always smaller in the former case than in the latter. The author has sought to find whether these additions really prevent a loss of chlorine. His experiments prove that all organic bodies determine by their incineration the decomposition of a certain amount of alkaline chloride. All the alkali is found in the ash, but not all the chlorine. The loss of chlorine is larger the smaller the proportion of alkaline salt to the organic matter. The addition of baryta, or of carbonate soda, lessens the loss of chlorine, which may even become *nil* if the addition is made extensive enough. Baryta requires to be added in larger amount than carbonate of soda. A second series of experiments proved that presence of phosphates is the cause why the chlorine is found too low. The author proposes the following mode of incineration :—Add hydrate of baryta to the extent of at least 10 per cent of the organic matter, ignite, dissolve the ash, which must be quite free

from carbon, in cold dilute nitric acid, and determine the chlorine and alkalies in the solution in the ordinary manner.

Turkey Red Dyeing with Artificial Alizarin.—In the use of madder, the oil-bath is followed by treatment with tannin; but when artificial alizarin is employed the oiled yarns are at once mordanted with alumina. The best alum mordant is prepared by mixing the solutions of 100 kilos. of crystallised alum and 15 kilos. soda crystals. The clear liquid should mark 4° B. The cotton is left an entire day in this solution. It is then washed carefully, wrung, and passed into a bath of alizarin and tannin (500 grms. tannin to 50 kilos. of yarn, alizarin 7·5 to 5 kilos.). When the water of the bath is not calcareous, chalk may be added to the extent of 100 grms. The bath should be cold at first, and is heated very gradually, a boiling temperature being finally kept up for an hour. The yarn is then, without clearing, treated with soap' and annatto. Salts of tin are only applied for rose shades.

Deep Maroon on Silks.—10 kilos. of silk are worked to saturation in a bath of 10 kilos. of catechu, and finally boiled for five minutes. It is immediately entered in a fixing-bath of 200 grms. bichromate of potash at 30°. It is well rinsed, and then dyed in a bath of 1 kilo. fustic, 200 grms. orchil, 100 grms. indigo-carmine, 500 grms. alum, and 100 grms. sulphuric acid. These proportions are varied according to the shade required.

Aniline Grey for Calico-Printing.—Ed. Lauber.—Dissolve 625 grms. chlorate of potash in 3½ litres of boiling water, and add when cold—

Gum-water at 1 kilo. ..	6·5 litres.
Sal-ammoniac	312·5 grms.
Chromo-potassic tartrate	1500 „ at 30° B.
Aniline	200 „
Tartaric acid	1160 „

To prepare the chromo-potassic tartrate, 960 grms. of bichromate of potassa are dissolved in 3 litres of hot water. When cooled down to 44° C. 1440 grms. of tartaric acid in powder are gradually added, avoiding a rise of temperature, which might modify the product. The preliminary reduction of the bichromate might be effected by an agent cheaper than tartaric acid, such as sugar. After printing the pieces are aged at 32° C. for forty-eight hours, and then washed for one hour. This grey is pure, and gives good grounds. It can be submitted to all the operations required for madder reds, except the passage through solution of tin crystals.

MISCELLANEOUS.

University of London.—The following are lists of the candidates who have passed the recent Examinations :—*First B.Sc. Examination (Pass List).*—First Division—F. W. Aveling, M.A., University and New Colleges; J. Boynes, St. John's College, Cambridge; J. W. Buck, private study; J. Bush, private tuition and study; T. Capper, private study; S. H. Carrington, Owens College; F. A. Cooper, University College; J. K. Crow, Owens College; G. Gates, B.A., University College and private study; R. Gill, Royal Institution School, Liverpool; F. Gotch, B.A., University College; J. S. Jellie, private study; T. Lattimer, Owens College; W. Lee, Owens College; D. McAllister, St. John's College, Cambridge; A. Matthews, Sidney Sussex College, Cambridge; J. M. H. Munro, College of Science, Dublin; W. Saise, Royal School of Mines; A. J. Smith, Owens College; G. Smith, Royal School of Mines; J. H. Ward, Crescent School, Margate. Second Division—J. K. Bond, B.A., private study; R. Capron, B.A., private study; J. Fewings, B.A., Queen Elizabeth's Hospital and private study; E. Jackson, B.A., Owens College Medical School; J. I. Paddle, B.A., Royal College, Mauritius; J. R. Rendell, Owens College; H. D. Waugh, B.A,, University College;

A. H. S. White, B.A., University College. *Examinations for Honours (First B.Sc. and Preliminary M.B. conjointly).*—*Chemistry.*—First Class—J. M. H. Munro, First B.Sc. and Prel. Sci. (Exhibition), College of Science, Dublin. Second Class—J. C. Uhthoff, Prel. Sci., Guy's Hospital; A. T. Wilkinson, Prel. Sci., Owens College Medical School; A. J. Smith, First B.Sc., Owens College. Third Class—T. Capper, First B.Sc., private study; A. Tilly, Prel. Sci., St. Mary's Hospital; G. Smith, First B.Sc. and Prel. Sci., Royal School of Mines; J. K. Crow, First B.Sc. and Prel. Sci., Owens College; R. Gill, First B.Sc. and Prel. Sci., Royal Institution School, Liverpool; F. H. Berry, Prel. Sci., Guy's Hospital; J. Wigglesworth, Prel. Sci., Liverpool School of Medicine; A. E. Maylard, Prel.. Sci., Guy's Hospital; A. R. W. Sedgefield, Prel. Sci., King's College; R. S. Wainewright, Prel. Sci., Guy's Hospital. *Experimental Physics.*—Second Class—A. Tilly, Prel. Sci., St. Mary's Hospital. Third Class—R. Gill, First B.Sc. and Prel. Sci., Royal Institution School, Liverpool.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the treatment of asbestos and in its application to various useful purposes in the arts and manufactures. Thaddeus Hyatt, Gloucester Gardens, Hyde Park, Middlesex. December 24, 1873.—No. 4241. This invention comprises the manufacture of asbestos chenille from short fibre asbestos for packing for steam engines. Attaching asbestos to any suitable backing by wire or other stitching or by cement like pile carpets, or like bristles in a brush-back, or forming the backing of cement or rubber solution making bearings and packing of asbestos by compressing it in moulds or holders in combination or not with anti-friction metal or alloy. Making a combination or admixture of molten metal and asbestos for the same purpose. Making packings of asbestos enclosed in a tubular open casing of open wirework or fibrous material braided, woven, or otherwise applied. Introducing a core of cotton, hemp, or cheap fibre into the centre of a rope packing of asbestos to economise the asbestos. The enclosing ropes, cakes, or blocks of asbestos in metal fail to render it merchantable and easy of handling. Making asbestos wadding or "batting" of teazed or corded asbestos coated with any suitable glaze or skin. Combining asbestos with earthy matter or with any animal or vegetable fibre dissolved or not in "copperised ammonia" and applied in a plastic state to the manufacture of various articles. Making artificial asbestos stone, also burnt bricks and tiles.

Improvements in extracting and utilising waste fatty and colouring matters contained in the washings of print- and dye-works. George Joseph Alfred Wuth, Accrington, Lancaster. (A communication from Richard Albert Forster, Augsburg, Bavaria). December 31, 1873.—No. 4286. At print- and dye-works, the printed or dyed goods are usually washed with soap and water to free them from any excess of colouring matter and other substances which are injurious to the brightness of the colours. The liquors used for that purpose, which now generally are allowed to run away, though they contain a large quantity of valuable colouring and fatty matters, can be made useful, and the improvements described in this Specification have the purpose to regain and extract the fatty and colouring matters out of these liquors.

A new or improved manufacture of nutritive hygienic compounds or preparations. Bristow Hunt, Serle Street, Lincoln's Inn, Middlesex. (A communication from Alvaro Francisco Carlos Reynoso, chemist, Paris). December 31, 1873.—No. 4290. The object of the present invention is to produce various preparations intended to serve as a complement to alimentation, by furnishing to the animal economy, under an appropriate form, perfectly definite as to quantity and quality, certain bodies or matters which are not always found in suitable proportions in food; in addition to which these bodies act as powerful means of regulating the performance of the functions of the human body. First preparation—Water, 300 grms. or parts by weight; lactophosphate of lime, 15; fluoride of potassium, 0·75; ammoniacal citrate of iron, 6; citrate of manganese, 1; citrate of potash, 1. Second preparation—Lacto-phosphate of lime, 15 grms. or parts by weight; fluoride of potassium, 0·75; water, 300; sugar, *quantum sufficit.* Third preparation—Containing fluoride of potassium (or of soda or ammonia) of from 0·25 to 20 grms. Fourth preparation—Pastilles or bonbons to be used containing powdered bone in its natural state without having undergone any manipulation other than the most forcible mechanical division in order to obtain an impalpable powder.

Improvements in the method of and apparatus for separating free sulphur from substances with which it is mixed. Samuel Henry Johnson, manufacturing chemist, Lea Bank Works, Stratford, Essex. January 2, 1874.—No. 19. This Provisional Specification describes certain improvements in the method of and apparatus used for separating free sulphur, by means of certain chemical agents, from substances with which it is mixed. Also modifications and improvements in the necessary apparatus therefor.

Improvements in making sesquicarbonate of ammonia. Gavin Chapman, manufacturing chemist, Glasgow, Lanark, N.B. January 3, 1874.—No. 38. This invention consists principally in vaporising

urine, gas liquor, or other ammoniacal liquor ; removing some of the liquor when the carbonic acid becomes deficient ; distilling ammonia from the removed liquor, carbonating it, and mixing it with the raw liquor.

Improvements in the mode of preventing the incrustation of boilers, and in the apparatus connected therewith. David Clovis Knab, Saint Denis, France. January 5, 1874.—No. 53. A solution of carbonate of lime is precipitated with a proportionate quantity of lime-white, and the water for defecation is led by a conduit to a continuous filtering apparatus, consisting of two, three, four, or more frames of iron, zinc, or wood, similar in construction, and boxing one within the other, and either square, round, or other suitable form ; within these frames a felt or other filtering substance is stretched, and when the matter to be filtered is very tenuous, a layer or layers of carded cotton having the filtering surface between two metal sheets is employed. The water arriving at the first filter is clarified after passing through the second and third ones. When the water is very impure the first filter becomes choked; it is consequently removed by levers, or otherwise, and cleansed in a water-bath. The whole column of filters is raised mechanically, and under the last a clean filter is placed ; the second becomes the first, the others following in rotation. The more frequently the first filter is removed, the quicker the filtering is performed. The water contained in the last filter still holds sulphate of lime in solution unprecipitated by the lime water, nevertheless the water is purified to the extent of two-thirds. To prevent this sulphate from injuring the heated sides of the generators, a proportionate quantity of ulmic acid is added to the water, which prevents the agglomeration of the salts by transforming them into mire.

An improved process for preparing hydrate of magnesia. William Edward Newton, civil engineer, Chancery Lane, Middlesex. (A communication from C. H. Phillips, New York, U.S.A.) January 6, 1874. —No. 72. This invention consists, first, in preparing a pure superhydrate of magnesia, by subjecting a soluble salt of magnesia to the action of a caustic alkali ; and, secondly, in preparing a medical compound, consisting of a superhydrate of magnesia mixed with water and termed " milk of magnesia."

An improved manure. John Frazer Corkran, Cannon Street, London. (A communication from Andrew Archbald, Florence, Italy.) January 7, 1874.—No. 87. This manure is composed of pine wood, sawdust, and animal blood, mixed and dried as soon after the animal is slaughtered as possible.

TO CORRESPONDENTS.

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THE CHEMICAL NEWS.

VOL. XXX. No. 774.

DETERMINATION OF HIGH TEMPERATURES
BY MEANS OF THE
REFRANGIBILITY OF THE LIGHT EVOLVED BY FLUID OR SOLID SUBSTANCES.

By JAMES DEWAR.

IT is well known that as the temperature of a solid is gradually increased, the refrangibility of the emitted light increases likewise ; and as the result we find red light emitted first, and gradually the other coloured rays appear until we reach the ultra-violet rays. This correlation between refrangibilty and temperature was first experimentally proved by Draper ;[*] and it would be a result of great importance to determine accurately the law of growth of refrangibility with temperature. If this could be achieved, a very easily applied and accurate pyrometer could be made of the ordinary spectroscope.

There are various difficulties, however, that beset this investigation at the outset. First of all, the rapid growth of the new rays confines the observations within narrow limits of temperature ; secondly, the want of equal sensibility of the eye for rays of all wave-lengths ; and, thirdly, the interference of diffused light preventing exact definition. It thus appears to be futile to attempt or even expect accurate observations in these circumstances through registration by the human eye, although, on first considering the subject, it appears to be a very easy matter. Finding no means of overcoming these difficulties, unless by the use of complicated apparatus, involving the use of rock-crystal prisms and lenses or fine gratings and the employment of photographic registration, requiring time and thought previous to execution, a series of observations have been made in the meantime on the increase of radiation with temperature, an inquiry of vital importance with regard to this subject.

Becquerel, in his treatise on Light called "La Lumière," has detailed a great number of observations on the growth of luminous intensity with increasing temperature. From these experiments he infers that "the differences between the logarithms of the luminous intensities are proportional to the differences of temperature," proving that an exponential function of the form

$$I = a(e^{b(T - \theta)} - 1),$$

where I is the luminous intensity, T the temperature of the body, θ the temperature at which the special ray begins to be evolved, a and b constants, and e the base of the logarithms adopted. The values of a and b, as deduced from the experiment, for the red ray are respectively 0·00743 and 0·005014. The above formula gives equally the growth of total luminous intensity if we take θ as 500° C., that point at which the light-rays begin to be evolved, and a and b as now having the respective values of 0·12053 and 0·00764. From the last formula Becquerel gives the following values of the total luminous intensity of a solid substance at different temperatures, stating it is probable the above law does not hold above 1200° C. :—

Temperature.	Total luminous intensity.
916 (fusion of Ag)	1
1000	4·37
1037 (fusion of Au)	8·38
1100	25·41
1157 (fusion of Cu)	69·26
1200	146·92
1500	28900
2000	191,000,000

* *Phil. Mag.,* 1847.

From the similarity of these formulæ with Dulong and Petit's law of heat-radiation, Becquerel regards them as being confirmed by analogy. The determinations of the temperatures in his experiments were all deduced from the intensity of the thermo-electric current of a platinum-palladium junction, and the luminous intensities were determined by means of a photometer based on double refraction.

The observations made in connection with this Report on the increase of total luminous intensity have been conducted similarly to those detailed by Draper in the *Philosophical Magazine* for 1847. The apparatus has been modified so as to be more conveniently employed, and the experiments made were found, on being tabulated, to be very well expressed by the following empirical formula :—

$$990 + n46 = n^2 I,$$

where I is the luminous intensity, and $990 + n46^3$ is equal to the total temperature—that is to say, above the temperal of 1036° C., by which time all the luminous rays may be considered present ; the intensity is a parabolic function of the temperature. The curve of increase is therefore a very acute parabola. ·

As the observations on increase of luminosity above 1000° C. can only be carried on for a range of 500° C. with the expansion of platinum, it was very essential that some comparison between the results of the empirical law given above and actual observation should be made at higher temperatures. For this purpose, a series of observations were made as to the relative light-intensity of lime heated to a temperature of 2000° C. in the oxyhydrogen flame, and the same substance at the boiling-point of zinc, temperature 1040° C. The following plan was adopted in making observations :—A square pencil of lime, four or five millimetres on the side, and of a length of 50 millims., was supported horizontally, and the inner cone of a powerful oxyhydrogen flame was made to play on a smooth cross section of the pencil. The light emitted from this perpendicular surface had to pass through a small circular aperture into an adjoining dark chamber for the purpose of comparison with the light emitted from an equal surface of lime, the temperature of which was near the boiling-point of zinc. In order to get a temperature maintained near 1000° C., I have adopted the following method :—A piece of platinum of an equal surface with that of the radiating lime, and of a thickness of 2 or 3 millims., was supported by means of a platinum wire in the flame of a good Bunsen burner, the position in the flame having been found by experiment to maintain the mass at near the temperature required. This latter fact was ascertained by finding the amount of heat, the platinum emitted when thrown into a calorimeter containing a known quantity of water. As the amount of heat emitted was very small, special precautions had to be taken in guarding the calorimeter and in getting the mass of platinum transferred. The calorimeter, containing about 100 grammes of water, was floated in a cistern (having been previously placed in the middle of a tin cylinder, leaving an annular space between), and so loaded that the water in the calorimeter was sunk to the level of the water in the cistern. The Bunsen burner was placed in a tin vessel loaded with shot, so as to give a flame the upper half of which was above the level of the water in the cistern. By this means constancy of temperature was maintained, and the results agreed closely together. It is easy to be convinced that a mass of platinum like that employed, radiating freely, is rarely heated above a temperature of 1100° or 1200° C. Comparisons were made between platinum in the Bunsen burner and lime in the oxyhydrogen flame, and also between lime in both.

The photometer employed for comparing the lights was on the principle of that recommended by Bunsen. A wooden box, about 8 inches long, 4 inches broad, 3 inches deep, containing several diaphragms with circular apertures, thoroughly blackened in the interior, and having the aperture of the middle diaphragm covered with a piece of

Swedish filter-paper, marked with one or two circular spots of paraffin, was employed to exclude extraneous light and to obtain good definition. By this means it is possible to obliterate completely the spot of paraffin, and thus gain greater confidence in the results.

From the mean of a great number of experiments made in this way, the luminous intensity at about 2000° C. is from 500 to 550 times that at 1040° C. The calculated amount given by the above formula for the exact temperature of 2000° C. is 484 times that at the lower temperature. According to the formula of Becquerel, it would be about 24,000,000 times that at the lower temperature. This empirical law, therefore, gives with considerable approximation the luminous intensity up to a temperature of 2000° C.

Total Radiation.—If the law of Dulong and Petit for the velocity of cooling was true for temperatures above the range of the actual observations made in support of the law, the amount of heat radiated per unit of time would be found by multiplying the velocity of cooling at the temperature considered into the specific heat at that temperature and into the weight of the substance. From this may also be calculated the amount radiated per unit of surface. In fact, for the same substance the relative quantities of heat evolved at two different temperatures would be to each other as the velocities of cooling if the specific heat and the emissive power remained constant. This would give an extraordinary rapid rate to the growth of total radiation. For instance, taking the temperatures of 2000° C. and 700° C., we find, according to Dulong and Petit's law,

$$\frac{Q_1}{Q_2} = \frac{a^{2000}}{a^{700}} = a^{1300} = 21{,}545,$$

where a is the constant 1·0077.

Thus a substance radiates at a temperature of 2000° C. 21,000 times as much heat per unit of time as it does at a temperature of 700° C.

In order to compare the total radiation as given from the law of Dulong and Petit with that of actual experiment, a series of observations were made, and the total heat evolved registered by the use of Pouillet's pyrheliometer. For this purpose, a spherical ball of lime, 8 millims. in diameter, was formed by carefully filing and polishing on the end of a narrow pencil of the same substance. This little knob of lime was then gradually heated, carefully turning it round, up to incipient fusion in the oxyhydrogen flame, so as to allow contraction to take place. With care in this way, it is possible to get a very uniform sphere having a surface of about one square centimetre. The pyrheliometer was filled with bisulphide of carbon, for the purpose of registering minute alterations of temperature. The experiments were made at two distinct temperatures, viz. at a low visible red heat, and at the maximum temperature of the oxyhydrogen flame. The mean of these experiments has given, for radiation per square centimetre per minute at about 700° C., from 20 to 25 gramme-units per minute, and at 2000° C. maximum temperature from 2000 to 2500 gramme units—the ratio of the amounts being as 1 to 100, very different from the calculated result. The law of Dulong and Petit, therefore, gives a far too rapid increase for the total radiation; and if we assume the law to be true in order to define temperature, the results arrived at are always too low.

If the total amount of radiation at different temperatures is tabulated, using a thermo-electric pile and an apparatus similar to the one employed for light-intensities, it is found that the curve of increase may be very accurately represented by a parabolic curve. The empirical formula of this curve is

$$580° + n3 \times 46° = n^2 R,$$

where R is the total radiation at 668° C., and—

$$580° \text{ C.} + n3 \times 46° \text{ C.}$$

is equal to the temperature of the substance. If we calculate the total radiation from the above formula at 2000° C.

as compared with that at 668° C., it is in the ratio of 1 to 112. Regarding these comparisons, they appear fairly within the limits of experimental errors. We would anticipate that a similar law would hold alike for heat-rays and light-rays.

Assuming these laws to be approximately correct, it is interesting to find what hypothetical temperature in the case of a solid or fluid substance would correspond with the luminosity and total radiation from the sun.

From the experiments of Fizeau and Foucault,* the luminous intensity of the sun is found to be 146 times that of the lime-light. A temperature of 13,000° C. according to the formula given above, would give 144 times the luminous intensity at 2000° C.

From the observations of Pouillet, the total radiation from 1 square centimetre of the sun's surface in 1 minute was 85,000 units, and cannot well exceed 100,000 units. At a temperature of 11,000° C., according to the above formula for total radiation, the amount would be 50 times that at 2000° C. Now we have found above that a square centimetre of lime at 2000° C. emits 2000 gramme-units per minute, so that a temperature of 11,000° C. would be sufficient to evolve 100,000 gramme-units, as much heat as is produced by the sun. The recent observations of Soret (*Bibliotheque Universelle* 1872) prove that the total radiation of the sun is between 50 and 60 times that of lime heated to 2000° C. in the oxyhydrogen flame. The estimate of 100,000 gramme-units per minute from the sun is therefore not too great, seeing that it is just 50 times the amount actually emitted by observation at 2000° C.

Experiments with Electric Arc.—The experiments formerly detailed to the Association on the specific heat of carbon up to a temperature of 2000° C. naturally suggested the attempt to define by observation the temperature of the electric arc, by determining the amount of heat evolved when pieces of carbon, heated between the poles, are thrown into a calorimeter. When a fifty-celled Bunsen's battery is employed, it is found that 1 gramme of carbon evolves as a maximum 850 units of heat when cooled from the temperature it acquires between the poles of the battery. This quantity of heat only corresponds to a mean temperature of 2000° C. in the heated carbon when the great increase in the specific heat of carbon is taken into account. In the experiments made with the battery, no precaution was taken to prevent the cooling of the piece of carbon between the poles from radiation, and consequently the substance never attained a uniform temperature. This fact is easily proved on examining the appearance of the carbon after use, when the substance is only changed into graphite in a few points. That temperature at which carbon changes into graphite may, in experiments of this kind, be used at a fixed point.

The luminous intensity of the electric arc, according to Fizeau and Foucault, is from 34 to 56 times that of the lime-light when 46 cells are employed, of small or large surface. According to the empirical formula previously given, this would correspond to a temperature of from 7000° C. to 8500° C.

In the course of the experiments with the battery, several determinations of the total radiation were made by the pyrheliometer. The mean of the observations, which were remarkably constant, corresponds to a radiation of 7100 gramme-units per minute, being equivalent to a solution of 4·5 grammes of zinc per minute. A concave parabolic mirror 1 yard in diameter, exposed perpendicularly to the sun's rays in this country, concentrates as much radiant energy as a 50-cell Grove's battery of large surface.—*Report of the British Association for the Advancement of Science,* 1873.

Food Adulteration Act.—Mr. Robert S. G. Paton, Ph.D., F.C.S., has been appointed Analyst for the Borough of Stirling, N.B.

* *Ann. de Chim. et de Phys.*, 1844.

ANALYSIS OF WATER TAKEN FROM THE "OLD CRESCENT WELL," HARROGATE, NOVEMBER 14th, 1873.

By THOMAS FAIRLEY,
Lecturer on Chemistry, Leeds School of Medicine, &c.; Consulting Chemist to the Yorkshire Agricultural Society; Public Analyst for Leeds.

ON THE MODE OF PRODUCING AURIFEROUS ALLOYS BY WET PROCESSES.*

By W. SKEY,
Analyst to the Geological Survey of New Zealand.

TEMPERATURE of the water, 47° F.; of the air, 44° F.; sp. gr. of the water, 1·00188. It contains, in grains, per gallon :—

I.	Calcium sulphate	0·031	containing	Anhydrous sulphuric acid	0·020	Lime	0·014
	,, carbonate ..	5·606	,,	Carbonic acid	2·464	,, ...	3·142
	Magnesium carbonate ..	4·095	;;	,, ,, ...	2·145	Magnesia ..	1·950
	Silica	1·128	,,	Silicic acid	1·128	—	—
2.	Sodium sulphydrate ..	0·568	,,	Sulphuretted hydrogen ..	0·345	Sodium.. ..	0·223
	,, carbonate.. ..	13·774	,,	Carbonic acid	5·718	,, ...	8·056
	,, sulphate	10·224	,,	Sulphuric acid..	5·761	,, ...	4·463
	,, chloride	88·167	,,	Chlorine	53·503	,, ...	34·664
	Potassium chloride ..	12·710	,,	,, ...	5·997	Potassium ..	6·713
	Calcium chloride	5·827	,,	,, ...	3·727	Calcium ..	2·100
	Magnesium chloride ..	6·862	,,	,, ...	5·128	Magnesium..	1·734
	Ammonia	0·022	,,	— — —		Ammonia ..	0·022
	Organic matter	0·970	,,	Organic matter, acids, &c.	0·970	—	—
	Total	149·987		Total acids, &c. ..	86·606	Total bases, &c.	63·081

The water contains traces of lithium, manganese, iron, barium, bromine, and iodine. The organic matter contains 0·006 of nitrogen; it consists partly of acids, some belonging to the fatty acid series, such as butyric, &c. The water contains the following gases, expelled by ebullition *in vacuo* :—

	Cubic inches per gallon.
Sulphuretted hydrogen ..	traces
Carbonic acid	6·85
Nitrogen	5·88
Carburetted hydrogen ..	traces
	12·73

As the well was inaccessible, the water had to be pumped up. It was taken after ten minutes' flow of water by pumping.

The substances bracketted together in (1) are those which are precipitated by boiling, while those in (2) remain in solution. In the absence of more definite knowledge as to how the acids and bases are arranged in combination, I have made use of the precipitations which happen on boiling as a basis of arrangement.* Of course, it is very probable that there are different arrangements at different temperatures. I have given the acids and bases separately to admit of more convenient comparison.

Analysis of the "Old Crescent Well" Water, expressed in parts per 1000.

Calcium sulphate	0·0005
,, carbonate	0·0801
Magnesium carbonate ..	0·0512
Silica	0·0161
Sodium sulphydrate	0·0081
,, carbonate	0·1968
,, sulphate	0·1460
,, chloride	1·2595
Potassium chloride	0·1815
Calcium chloride	0·0832
Magnesium chloride.. ..	0·0980
Ammonia	0·0003
Organic matter	0·0138†
Total	2·1351
Total by simple evaporation	2·1249
Chloride of lithium	trace
Sulphate of barium	,,
Carbonates of iron and manganese	,,

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* The dry solid residue was treated with cold water, and the filtrate and insoluble matter analysed separately.
† Containing 0·0008 of nitrogen.

IN former papers read before this Society,† I showed that metallic sulphides generally reduced gold from both acid and alkaline solutions; that silver, as nitrate, was reduced by galena and sulphide of copper, but not by iron pyrites, while its ammoniated solutions were unaffected by any of the sulphides experimented with; and, from a consideration of these results, I suggested that most of our native deposits of noble metals have been formed by the agency of metallic sulphides, and not by that of organic matter, as has hitherto been generally supposed.

The question which naturally presented itself to me at the time, as to the capability of processes of this nature producing alloys of such metals (as found in Nature), was tacitly left over for consideration until the behaviour of these sulphides with metallic solutions should be more fully examined.

In pursuit of this question as to the possibility of obtaining mixed metallic deposits or alloys by the agency of metallic sulphides, I have from time to time, as opportunity offered, studied the behaviour of different sulphides when in contact with various salts of gold and silver, and the principal results thus obtained I now beg to state.

1. That solutions of chloride of silver in alkaline chlorides, rendered alkaline by addition of potash, soda, or lime, are readily decomposed by common iron pyrites.

2. That this effect is not produced if such solution of silver is either acid or neutral.

3. That when chloride of gold is added to an alkaline argentiferous solution of this nature, such mixed solution is capable of depositing the metals contained in it in the form of coherent alloys upon metallic sulphides generally when presented to them.

4. That these alloys can also be formed from such solutions by voltaic action.

As will be seen, these results show that, by allowing an alkaline solution of gold and silver contact with iron pyrites (a mineral of most common occurrence in our reefs), we obtain that mixed deposit or alloy we are seeking to produce.

The only condition which appears to me, from the results of numerous experiments, necessary in regard to such metallic solutions is that they should be not only alkaline, but alkaline from presence of a fixed alkali or alkaline earth, and it will be remembered, perhaps, in connection with this circumstance, that this alkaline condition is one which I have recently shown‡ to be that of our silicates generally, whether simple or compound, with the exception of silicate of alumina and other corresponding silicates of the sesquioxides, while quartz itself,

* Read before the Wellington Philosophical Society.
† See *Trans. N. Z. Inst.*, vol iii., Arts, xl. and xli.
‡ *Trans. N. Z. Inst.*, vol. iv., Art. lvi.

whether free or in combination, is either quite neutral or of such very feeble acidic powers as regards intensity that, when united, even in very greatly disproportionate quantity, with alkalies or alkaline earth, the resulting compound gives an alkaline reaction,

If such, then, are the conditions (alkalinity or neutrality) of our surface rocks generally, it is clear that the condition of the water permeating them at some distance from the surface would be alkaline, the intensity of which would be largely increased were the retaining rock subjected to those hydro-chemical influences popularly supposed to have operated for the deposition of their older vein matters and their metallic contents,

The fact that many mine-waters are acid does not affect the truth of the conclusion thus drawn as to the general alkaline condition of the waters charging our rocks, since this acidity is, as is well known, brought about by the contact of air with pyritous matters, metallic sulphates thus being formed, which communicate an acid reaction to water dissolving them. This is a mere surface affair as it were, and is besides in its manner of production entirely distinct from, if not antagonistic to, that by which gold has been deposited in the pyritous portions; for a slight examination of these shows that the gold present in them has been deposited there before they were oxidised by atmospheric agency.

Alkalinity being, then, certainly the general condition of our waters permeating rocks closed, or partially so, against the atmosphere, and this condition of liquids appearing essential for the production of alloys by humid methods, as shown here, it does seem highly probable that our native alloys of gold and silver have been deposited from *alkaline* solutions, and by such agents as I have suggested, viz., the metallic sulphides.

I will only add, in reference to the mode in which our deposits of native gold have been formed, that, while the number of substances capable of precipitating this metal from solution is many, the number of those at all likely to have been actually concerned in the production of these deposits is very small indeed. As far as at present appears, the substances capable of reducing gold, and likely to occur in the interior parts of our rocks, are ferrous sulphate of iron, organic matter, and metallic sulphides. These also reduce silver from certain of its solutions, but, as already noted, the difficulty is in finding a substance which will reduce these two metals simultaneously in coherent forms, and from such kinds of solutions as generally permeate our rocks. With this double duty to perform, and limited in this manner as regards nature of solvent, I cannot avoid thinking that but one of these reducing agents, the metallic sulphides, will be found equal to the occasion. The ferrous sulphate is thrown out at once from this service on account of its insolubility in such a menstruum, while organic matter appears to have a decided tendency to scatter the gold it reduces, nor have we, as far as I am aware, produced any true alloy of gold and silver by their use.

I would not intend to convey the idea that such a mixed deposition is impossible, but only that, from what we at present know of this subject, the production of such an alloy by these means appears a very difficult undertaking. However, this particular question has, I understand, been dealt with by Mr. Daintree, late Assistant Geologist to the Victorian Geological Survey,* so that the propriety or otherwise of retaining this theory of the origin of our auriferous deposits in their lodes by the inter-action of organic matter may be left in abeyance until Mr. Daintree publishes the results of his inquiry, as promised.

I will therefore leave the question in this state, merely observing that, should Mr. Daintree be unable to obtain the results he is in search of, I shall then claim for our metallic sulphides the sole duty of depositing at least that portion of our native gold which occurs in the reefs or fissures of our metamorphic rocks.

* *Athenæum,* July 22, 1871.

ON THE
LAW OF COLOUR MIXTURES AND THE PHYSIOLOGICAL FUNDAMENTAL COLOURS,
By M. BOUTY.

FROM physiological researches, and chiefly from observations on individuals who are colour-blind, Helmholtz has been led to enunciate the view that all the colour sensations of which we are susceptible may be awakened by the mixture, in suitable proportions, of three colours, viz., red, green, and violet-blue, which he has named, for this reason, *fundamental physiological colours.* The obscure problem of mixture of colours becomes susceptible, on this hypothesis, of a rational and elegant solution, the principal features of which, as given in a recent memoir by M. Von Bezold,* we propose shortly to explain.

Let us take, arbitrarily, in a plane, three points, A, B, and C, to represent the three fundamental colours in order of refrangibility; and let a colour be mixed, containing these three colours in the proportion of the numbers P_1, P_2, and P_3. We may represent it by the point M, centre

of gravity of weights respectively equal to P_1, P_2, and P_3, placed at A, B, and C. Thus all colours will be found represented in the interior or in the sides of the triangle without ambiguity; and to each point in the table a determinate colour will correspond.

The binary mixed colours are situated in the perimeter of the triangle; thus, from A to B range orange and yellow tints, from B to C blue tints, and, lastly, from C to A the purple tones resulting from a mixture of red and violet, and which have no representatives in the solar spectrum.

White will be somewhere in the interior, at a point O.

If, from O, we proceed in the direction ON, we pass by insensible degradations, from perfect white to a pure binary colour, a blue, *e.g.*, but all the intermediate colours are characterised by the same *tone* more or less diluted. We may, indeed, consider, all these colours as mixtures of white and of blue; and a point M of the line ON is the centre of gravity of the suitable weights placed, respectively at O and N. We see that the colour N is *saturated,* and we designate, as the *degree of saturation* of the colour M, the relation—

$$\frac{OM}{NO}$$

of its colour intensity to its total intensity.

It will be easily established that two opposite directions, ON and ON', correspond to complementary tones, and that white may result in an infinite number of ways from the combination of two binary or ternary colours.

Just as we may compose and decompose forces into systems varied *ad infinitum,* we may produce the same physiological colour in an infinite number of ways; but, to define it fully, three quantities are always required; either the intensities

* *Poggendorff's Annalen,* tome cl., pp. 93 and 121.

of the three fundamental components, or certain other three data, subject to the condition of our being able to determine the intensity of a force and its point of application in a plane. The most convenient choice consists, perhaps, in defining a colour by the tone; that is to say, the wave-length of the corresponding binary colour, the intensity of the white light which it contains, and the degree of saturation. For purple tones, which have no proper refrangibility, there is given the wave-length of the complementary green.

The wave-length of a binary colour, N, defining the latter without ambiguity, is a function entirely determined by the position of the point N, but this function is unknown *à priori*. The most simple form which can be given to it is obtained by supposing that the distance of the point N, reckoned from a fixed origin, N_0, in the direction N_0ABC, is proportional to the number, n, of vibrations of the colour. If we provisionally accept this form of the function, we may express, by a very simple relation, the property of complementary colours. Draw, from the point O, the parallels Oa and Ob to the sides BC and AB of the triangle. The similarity of the triangles $N'aO$ NbO gives—

$$\frac{N'a}{aO} = \frac{Ob}{Nb}.$$

Or, putting a and β for the numbers of vibrations corresponding to the colours a and b; n and n' for the numbers of vibrations of the complementary colour NN'—

$$\frac{a-n'}{aO} = \frac{Ob}{n-\beta}$$

$$(n-\beta)\,(a-n') = aO.Ob = \gamma^2,$$

γ denoting a constant. If n and n' be considered as current co-ordinates, this formula represents a hyperbola. Now the researches of M. Helmholtz and M. Müller furnish wave-lengths observed from a great number of complementary colours, and it is verified that the configurative points of each couple of observations are situated sensibly in the same hyperbola. Thus the author's hypothesis is justified.

If one might reckon with absolute exactness on measurements so difficult as the precise determination of complementary colours, the construction of the hyperbola would furnish the values of a and β, that is to say, would determine the position of white on the table; but very small differences in the position of the hyperbola correspond, unfortunately, to considerable variations of the parameters a and β. We can only, then, accept the results with some reserve. We have, according to the author, $Oa = Ob$; that is to say, white will be found in the bisecting line of the angle ABC. The number of vibrations, n_2, of the fundamental colour B will thus be—

$$n_2 = \frac{a+\beta}{2},$$

and will correspond to 596 billions of vibrations per second. This number is exactly the mean of the numbers of vibrations corresponding to the extremities of the spectrum.

Considerations still less certain than the preceding lead to our adopting, for n_1 and n_3, corresponding to the fundamental colours A and C, the numbers 465 and 725 billions per second. The mean of these numbers being exactly 596, the table of colours will be an isosceles triangle, and, as the length of the side AC is indeterminate, we may make the triangle equilateral.

It remains to place in the table the spectral colours themselves. On account of the uncertainty of the data on which rests all this part of the memoir, we must refer the reader to the original work. He will find, on this subject, and more generally on the physiological theory of M. Helmholtz, a large number of interesting details; in particular, an indication of the experiments which should be made in order to dispel the uncertainties that still abound in this curious chapter of physics.—*Journal de Physique.*

MISCELLANEOUS CHEMICAL NOTES,

By S. DANA HAYES,
State Assayer for Massachusetts,

I. *Deposits in Boiler Tubes.*

THE causes of frequent failure and leakage in the small iron flue-tubes in tubular steam boilers have lately been investigated by expert engineers, and analyses made of the deposited materials found in these tubes, both before and after they have failed, indicate the cause of failure in many cases. These tubes are cleaned at intervals, when the boilers are in use, with cylindrical wire brushes, and when only dry dust or a little soot is drawn out by these brushes the tubes may be considered to be in good condition. But there are frequently deposits in the tubes that are pasty in places and roll along under the cleaning brush like pieces of dough, or the quantity of dry powder deposited in the tubes may be quite large; in such cases there is danger of rapid corrosion and weakening of the iron, and analysis should be made of the deposited material removed by the brushes in order to determine its nature and source.

These deposits are of two kinds, both of which are capable of corroding the iron rapidly, especially when the boilers are heated and in operation. The most common one consists of soot (nearly pure carbon), saturated with pyroligneous acid, and contains a large proportion of iron if the deposit is an old one, or very little iron if it has been recently formed. The other has a basis of soot and fine coal-ashes (silicate of alumina, &c.), filled with sulphur acids, and contains more or less iron, the quantity depending on the age of the deposit.

The pyroligneous deposits are always occasioned by want of judgment in kindling and managing the fires. The boilers being cold the fires are generally started with wood, and when partially under way they are nearly extinguished ("smothered") with large charges of coal or wood; pyroligneous acid then distils over into the tubes, and, collecting with the soot already there from the first kindling fires, forms the nucleus for the deposits, which soon become permanent and more dangerous every time wood is used in the fire places afterwards. If the coal or wood is not used in excessively large charges nothing but dry soot collects in the tubes, and much of this is ultimately burned or carried into the chimneys by the hot draft from the fires. The sulphuric deposits derive their acids from the coals used, but the basis material holding these acids is at first occasioned by shaking or cleaning the grates soon after adding charges of fresh coal to the fires, and by thus driving fine ashes forward into the small flues at the opportune moment for them to become absorbents for the sulphur compounds distilling from the coals, and corrosion of the iron follows rapidly after these deposits.

In one instance considerable quantities of sulphur acids were found in the tubes of a boiler where no coal had been used, but it was discovered that the fuel employed consisted largely of old staves and boxes impregnated with alum, copperas, sulphate of copper, &c. In other cases small particles of distilled sulphur have been found in the tubes.

It is obvious from what I have written that the fires under tubular boilers should be managed with more judgment than is usually bestowed upon them; the fuel should never be used in large charges at one time, but the fires should be frequently renewed with smaller charges; and the grates should be cleaned only when the fires are bright on top.

II. *Lignite from Louisiana.*

Brown coal, of which there are considerable deposits in the banks of the Mississippi river, about two miles below Shreveport, in Louisiana, has been recently proposed as fuel for the steamboats on the rivers. Analyses of air-dried specimens representing these deposits have yielded the following average results:—

100 parts contained—

Water	15·26
Volatile matter (bituminous) ..	41·30
Fixed carbon (coke)	37·55
Sulphur (merest traces)	—
Ash..	5·89
	100·00

This lignite has a specific gravity of 1·143, it is nearly black in colour, and its ligneous structure is not so distinct as usual, but it dissolves completely in caustic soda solution.

III. *Waters of Prince Edward Island, Nova Scotia.*

There is probably no city of 10,000 inhabitants on this continent that is suffering more for want of pure water than Charlottetown, the capital of Prince Edward Island. The public and private wells of this city are unfit for use from the presence in them of animal matters in uncommonly large proportions, and they undoubtedly constitute the primary cause for some of the diseases prevailing among the people there. The inhabitants of this city are literally "dependent upon a water cart or two and a spring just out of the city limits for every drop of water fit to use for cooking or drink;" and this water, which is itself not by any means one of the best, is sold from the carts for nearly 1 cent per gallon. For more than two years the city council have had this matter under consideration, and the first complete analyses of their waters were made in November, the sources of the different specimens being unknown at the time. In recording only partial results of these analyses, it should be understood that the constituents called *organic matter* consist of the volatile matters after correction and deduction of carbonic and nitric acids, water of composition, &c., belonging to the mineral and saline constituents determined by full analyses.

One United States gallon (231 cubic inches) of these waters contained in grains—

Source of Waters Analysed.	Inorganic Matter.	Organic Matter.	Total Weight of Residue.
City pump well	50·61	5·95	56·56
Park spring..	5·05	3·17	8·22
Winter river, six miles from the city .. .. }	4·21	2·46	6·67

The well water contained nitrate of potash in sufficient quantity to admit of its separation by crystallisation; and the predominating constituent in the residues from the other specimens was sulphate of lime. There is now every reason to suppose that the water of Winter river will be brought into Charlottetown before long, through a proper system of supply pipes, although the same partisan feeling on the "water question" finds expression there as elsewhere.

IV. *Opium in Commercial Medicines.*

The attention of public health officers has been drawn to the increasing consumption of opium and morphia in the cough mixtures, tooth washes, lotions, liniments, and other preparations now so freely offered for sale by vendors of patent medicines; and, as the subject is one of importance, brief mention of these few cases, among others that have come under my observation, will not be out of place.

Some analyses, recently made here of medicines intended for internal use, have shown the quantity of morphia present in several of them to vary from ¼ grain to 1½ grains in the dose recommended by the printed directions accompanying the medicines. One nostrum, a sure "Cure for the Opium Habit," was found to be a clear solution of sulphate of morphia, coloured pink by aniline red, and sweetened with sugar; and a dose, containing very nearly 2 grains of sulphate of morphia, was to be taken three times a day by the patient when suffering severely from depression and other symptoms. The "brandy," sold by a dealer of

medicines in the country, was found to have been mixed with laudanum and extended with water in such proportion as to insure large profits, but it contained morphia equal to 2½ grains of opium in 4 fluid ounces of the "brandy." A tooth-wash contained nearly four-tenths of a grain of morphia in each fluid ounce; and a cough mixture more than three-tenths of a grain in the dose directed for a child.—*American Chemist.*

NOTICES OF BOOKS.

Physiology. By F. LeGros Clark, F.R.S. London: Society for Promoting Christian Knowledge.

A TREATISE on animal physiology, even as applied to the human species alone, cannot, without great concision, be compressed into the brief compass of 126 pages. As a matter of course only the leading facts of the science are given. To the trained student it must also seem strange that one group of organs and their function have, probably in obedience to the Essene traditions which linger more strongly in England than in any other civilised country, been altogether omitted. To seek for errors in an account of the human frame and its functions drawn up by such an authority as Professor Clark would be idle in the extreme. Many interesting questions which the modern development of science is bringing more and more into prominence, are either merely glanced at, or totally overlooked. But regard being had to the obvious destination of the work, it may be said that abstruse researches and still more doubtful views would here be out of place.

Dr. Pereira's Elements of Materia Medica and Therapeutics. Edited by R. Bentley, M.R.C.S., F.L.S. and Theoph. Redwood, Ph.D., F.C.S. London: Longmans, Green, and Co.

ON a work of a character so established as that of Dr. Pereira's little need be said. The present edition has been improved in its arrangement, and brought up to the present state of chemical and pharmacological knowledge.

The Retrospect of Medicine. Edited by W. Braithwaite, M.D., and Jas. Braithwaite, M.D. Vol. LXIX., Jan. to June, 1874. London: Simpkin and Marshall.

WE quote from this work a notice of the remarkable solvent action of Papya juice on the nitrogenous articles of diet. Dr. G. C. Roy having found that in India cooks are accustomed to add a few drops of the milky juice of Carica papya to tough meat to make it tender, instituted a variety of experiments on the subject. He found, in fact, that the drug has a remarkable disintegrating power upon animal matter, without, however, promoting putrefaction. It may, not impossibly, be a nitrogenous ferment, standing in the same relation to albumenoid bodies as yeast does to starch. The plant does not appear to possess any poisonous properties, and the meat which had been the subject of the author's experiments was repeatedly eaten by a cat without injury.

CORRESPONDENCE.

PRECIPITATION AND ESTIMATION OF FATS.

To the Editor of the Chemical News.

SIR,—In reference to my letter on this subject in CHEMICAL NEWS, vol. xxx., p. 135, a slight printer's error occurs; instead of a room heated to 680° F., it ought to have been 68° F.

Further experiments have proved that half an hour suffices to effect the full precipitation of fats from their ethereal solutions by the addition of twenty drops or so

of alcohol to the dram of ether, containing not more than 25 grains of the adulterated butter; after which the tube should be agitated and its contents projected on to a small double filter, washed with a little alcohol, and the residue, whilst moist, scraped off and transferred to a watch-glass to dry. In this way, loss by melting and absorption into the paper is obviated.

The following were the proportions of the fats I recovered, viz. :—

Lard	60 per cent.
Mutton fat	75 ,,
Beef	95 ,,

The precipitated mutton fat is powdery, and as white as snow. Lard and beef are more adherent and greasy; from that reason mutton makes the firmest compound.—I am, &c.,

JOHN HORSLEY.

Cheltenham, September 19, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 5, August 3, 1874.

Double Series of Drawings Representing Terrestrial Whirlwinds and Solar Spots.—Executed by M. Faye.—Not adapted for abstraction, as frequent reference is made to the figures.

Eighth Note on Guano.—M. E. Chevreul.—The author states that until recently he had not detected in guano any compound of sodium except the chloride, mixed with chloride of potassium. Recently he has found in guano the ammonia-phosphate of soda. The salts which he has hitherto recognised in guanos are—carbonate and hydrochlorate of ammonia, phosphate, oxalate, and urate of lime, avate of potash, and two or three salts of potash, the acids of which are volatile, and smell like phocenic acid and its analogues. The following double salts are certainly present:—Ammonio-oxalate of potash, ammonio-sulphate of potash, ammonio-phosphate of soda, ammonio-phosphate of magnesia. The occurrence of the ammonio-phosphate of potash is doubtful. Chlorides of sodium and potassium are also present.

Meteorite which fell May 20, 1874, at Virba, near Vidin, in Turkey.—M. Daubrée.—The fall was attended by a loud noise. The mass, weighing 3·6 kilos., penetrated into the soil to the depth of 1 metre. It is entirely covered with a dull black layer. Its fracture is stoney, of a light grey, finely granular, and rough to the touch. In the mass are scattered numerous grains of a metallic lustre. In thin layers the stoney grains are transparent, nearly colourless, and act upon polarised light. The metallic portion consists of iron-grey irregular grains of nickeliferous iron, with which are mixed sulphide of iron, and numerous minute grains of chrome iron. The non-metallic portion forms a jelly with weak hydrochloric acid after the manner of peridote.

Indication of a Method for Determining the Properties of the Ether.—M. X. Kretz.—In order to explain certain classes of physical phenomena we have, in general, recourse to the hypothesis of an inert and imponderable medium extending through space, and which has received the name of ether. For a certain time, and especially since the discovery of the principles of thermo-dynamics, the attempt has been made, in certain mechanical theories, to introduce the consideration of ether, or that of some other element having an equivalent mode of action. In such attempts the new hypothesis has been placed in juxtaposition with dynamics, without examining if the method adopted is legitimate. The author shows that the supposition of an element exterior to matter is irreconcilable with the definition of matter, as it results from the fundamental principles of dynamics. If we then find it useful or necessary, for the explanation of certain phenomena, to assume that beyond matter there exists another element or medium of whatsoever constitution, it becomes at the same time needful to modify the interpretation of the bases of mechanics, so that the whole of the doctrine may repose upon compatible principles.

Thermic Effects of Magnetism.—M. A. Cazin.—If m is the quantity of temporary magnetism of an electro-magnet, l the polar interval, Q the number of calories created by the disappearance of the magnetism, A a co-efficient constant for the same magnetising coil, and the same disposition of the circuit, then $AQ = m^2 l$. If the magnetism is only employed to produce heat in the nucleus, the coefficient A will be constant, and will measure the number of unities of magnetic energy equal to 1 calorie. This will be the magnetic equivalent of heat. To find it, it is necessary to find the absolute value of Q and of $m^2 l$. The author has made two series of experiments for this purpose, the first to ascertain if A is a constant, and the second to find the value of Q.

Researches on Explosives.—M. Noble and F. A. Abel.—A continuation of the first memoir of these two chemists.

Fourth Note on the Electric Conductivity of Woody Bodies.—Th. du Moncel.—The object of the present paper is the study of the variations of the conductivity of woods, according to the length of the section.

Passivity of Iron.—P. de Regnon.—The author made use of iron wires protected, for a certain length, by glass tubes or layers of varnish. The free extremity, for the length of 2 to 3 centimetres, could be entirely plunged into the acid. An electric current entering by the iron into any nitric acid soever, renders it passive as long as the current lasts, with liberation of oxygen almost pure. On breaking the current the iron remains passive. A current taking its exit by the iron destroys the passivity—a change of condition which may be repeated indefinitely. Iron acting as positive electrode in a mixture of sulphuric acid and water liberates oxygen, is slightly attacked, and is rendered passive for nitric acid. A reversal of the current destroys the passivity. The action of nitric acid upon iron may be stopped by touching it, or better by rubbing it within the acid with a conducting body not attacked by the acid, such as platinum or charcoal. This action of carbon explains why steel and cast-iron become spontaneously passive. The more concentrated the acid, the more readily passivity is produced. The contact of an attackable metal destroys passivity. If, therefore, we bring in contact two iron wires, the one passive and the other active, the result may be either the passivity or the attack of both. The end of a wire may be washed in water without destroying its passivity, provided care is taken not to immerse the wire beyond the protecting varnish. The wire may even be scraped under water with another passive wire, or with the end of a clean glass tube, without altering its condition. This experiment completely overturns the explanation of passivity by the assumed formation of an insoluble layer on the surface of the wire. Oxidising agents are without action upon passive wire, but deoxidising bodies destroy the passivity. Most causes which produce passivity may be reduced to a voltaic force carrying the oxygen to the iron, and polarising it upon the surface of the metal. On the other hand, the majority of the causes which destroy the passivity of iron may be reduced either to a voltaic force in the opposite direction, or to a current due to the polarisation of the oxygen, and by which it is exhausted; or, lastly, to an absorption of the polarised gas by a body greedy of oxygen. We can now understand two experimental precautions insisted on above. It is necessary to protect the portion of the wire not plunged into the acid by an impenetrable coating,

otherwise the acid vapours would place this portion in a state opposed to the passivity of the immersed portion. Again, when washing the passive extremity in water; if the metal is immersed beyond the varnish we close a circuit, by which the polarisation is exhausted, and the passivity destroyed.

Certain Minerals of Bismuth and Tungsten from the Mine of Meymac (Corrèze).—A. Carnot.—The sulphide of bismuth from this mine is distinguished from ordinary bismuthine by a lead colour, verging upon blue, like that of sulphide of antimony. Its sp. gr. is 6·60. Its composition is—

Bismuth	78·40
Lead	0·75
Copper	0·40
Iron	0·53
Antimony	0·85
Arsenic	3·10
Sulphur	14·25
Gangue	0·90
	99·18

The mineral contains neither tellurium nor selenium; some samples show traces of cobalt. This analysis points to a formula distinct from that attributed to bismuthine, Bi_2S_2. It may be considered as a new species—
$$16(Bi,Pb,Cu_2,Fe)S + (Sb_2,As)S_3.$$
Hydrated carbonate of bismuth, found in abundance in the mine, is produced by the alteration of the sulphide by atmospheric agencies. It preserves the half-fibrous, half-lamellar condition of the original mineral. Its sp. gr. varies from 6·81 to 7·20. Its colour is grey, greenish grey, or whitish yellow. It is readily attacked by acids, with effervescence, yielding a yellow solution. Three samples were analysed:—I. Greyish white; sp. gr. 6·94; II. deep grey, fibrous, sp. gr. 7·26; III. white, earthy, sp. gr. 7·08.
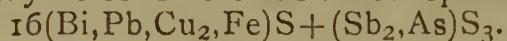
	I.	II.	III.
Oxide of bismuth	89·75	87·50	86·90
Oxide of lead	0·55	0·44	0·40
Oxide of copper	traces	,,	,,
Oxide of iron	0·53	0·50	0·43
Lime	0·35	0·55	0·38
Magnesia	traces	0·07	0·05
Sulphuric acid	0·25	0·22	0·13
Arsenic acid	0·73	0·80	0·65
Antimonic acid	0·57	1·25	1·20
Hydrochloric acid	0·37	0·20	0·14
Carbonic acid	3·74	4·15	5·35
Water	2·76	3·55	3·02
Gangue	0·20	0·30	1·10
	99·80	99·53	99·57

This mineral evidently belongs to the same species as the "Bismuth Ochre" of Schneeberg, and the bismuth spar or bismuthite of South Carolina.

Photographic Reproduction of Microscopic Crystallisations.—M. J. Girard.—The arrangement would be more intelligible if accompanied with an illustration.

Isoterebenthen from a Physical Point of View.—M. J. Ribau.—The author gives the boiling-point, rotatory power, density at different temperatures, and index of refraction.

Constitution of Ordinary Bromated Propylen.—M. E. Reboul.—Not adapted for abstraction.

Action of Nitric Acid upon Paraffin; Products Resulting.—A. G. Pouchet.—The paraffin is converted into paraffinic acid, a solid, yellowish white body, insoluble in water, soluble in alcohol, ether, chloroform, benzol, &c. The acid fuses at 45° to 47°, and at temperatures slightly higher is decomposed.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, No. 15, 1874.

The Moon and Mycoderms.—M. Charbonnier asserts that at the period of the equinoxes the water of aquariums becomes greenish, and the sides grow dirty to such an extent that they require cleaning several times daily to preserve their transparency. These germs produce a periodical mortality among fish, which the author ascribes to the sudden and disproportionate growth of mycoderms at the time of the full moon, and especially at the equinoxes.

Identity of the Period of Photospheric and Magnetic Phenomena in Connection with the Proper Movement of the Sun.—P. Rosa.—The secular photospheric and magnetic variations undergo a simultaneous oscillation of a period of 66⅔ years. The perigee of the apparent orbit of the sun oscillates according to the same period. The decennial period, according to Lamont and Sabine, or the endecennial according to Wolf, Hansteen, and Quetelet, connects not only the magnetic variations and the solar activity, but also the variations of the diameter of the photosphere. Although the period of the above-mentioned oscillation remains approximately the same the mechanical perturbations of the solar perigee, and the changes of photospheric form, as well as the intensity of terrestrial magnetism, demonstrate evidently that the solar system is at present removing from the seat of the force which produces the phenomena in question. It follows that this force centres in a celestial body outside the planetary system.

Action of Atmospheric Vapour on the Heat, whether Luminous or Obscure, of the Solar Radiations.—F. S. Provenzali.—The author finds that the luminous heat and the dark heat do not maintain a constant relative relation, but that the one often increases while the other diminishes.

Reimann's Farber Zeitung, No. 25, 1874.

This number contains instructions for dyeing feathers black and brown; for an alkali (Nicholson) blue on old silks; for dressing cleaned and re-dyed velvets; for printing steam reds and roses (cochineal and peach-wood) on calico; for dyeing a swallow-blue on woollen piece goods; and a bright green on woollen yarn.

No. 26, 1874.

This number contains a continuation of the article on dyeing and finishing plushes; receipts for a buff and a mode grey on garments (cotton warps), and a rose-brown on woollens; a curious receipt, extracted from a contemporary, for producing an orange on silks by working for three quarters of an hour in nitric acid at 5° B., and then for a quarter of an hour in a soap-bath; a blue without indigo on wool to stand milling, which we give at length. For 120 lbs., boil two hours with 3 lbs. blue vitriol, 3 lbs. salts of sorrel, 15 lbs. alum, 6 lbs. tartar, and 2 lbs. chromate of potash. Let cool in the dye-liquor, and then boil for two hours with 56 lbs. campeachy logwood. This colour not only resists milling, but takes a finer blue tone from that process.

Aniline Blue Printing Colour for Cottons.—

Acetate of alumina at 14° B.	1 litre.
Bisulphite of soda at 25° B.	1 ,,
Strong gum-water	2 litres.
Aniline blue	100 grms.
Hot water	⅛ litre.

The calico may either be printed with this mixture without any previous preparation, or it may be padded in soap-lye containing 50 grms. of white soap per litre. Pieces thus prepared take the colour better. After printing dry, steam for an hour and a half, wash, pass quickly through soap-lye at a hand heat, and clear in water slightly acidulated with hydrochloric acid, rinse, and dry. This method completely replaces the common and dangerous arsenical process.

Then follow receipts for "topped" vat-blues on mixed goods (cotton warps), and general instructions for woollen dyeing.

Aniline Blacks.—According to Kruis, of Prag, all the heavy metals produce a black colour by their action upon the chlorate of aniline. Either immediately, or on the application of heat, a dark green insoluble pigment is produced, which, on exposure to the air, turns black or dark grey. If the residual liquid is filtered off, it is found to contain magenta. A brown colour is also produced, soluble in alcohol. Few metals, however, are suited for producing a deep black on the fibre. Besides copper, which is generally employed, there are only cerium, iron, and manganese. Uranium gives only a grey. Cobalt and arsenic yield dark blue tones. Gold, platinum, antimony, molybdenum give medium blues. Light grey is produced by uranium, tin, chrome, nickel, bismuth, lead, and zinc. These statements cannot be quite correct, since the salts of chrome are widely and successfully employed in print-works for the production of a fine aniline black.

No. 27, 1874.

This number contains an editorial note on the unsatisfactory state of the tinctorial trades; the causes enumerated being competition in low charges, the doubtful condition of textile manufactures, and the recent rise in wages. There are receipts for a red, black, brown, and green upon woollen yarn, all capable of bearing milling; an olive on woollen yarn and pieces; a blue for printing on cotton and mixed pieces; and a salmon and a stone colour on cotton yarns.

Aniline Black.—According to Kruis, the aniline black developed by bisulphate of cerium surpasses all others in intensity, brightness, and fastness. The material is expensive, 12s. per kilo. The amount required is only one-fourth or one-fifth part of the weight of sulphide of copper commonly used. The action is rapid, and the fibre is not at all injured. The colour becomes merely a dark green in the ageing house, and only takes a full black in the alkaline bath. The instructions for working the new indigo vat of Schützenberger and Lalande will be given when completed.

Revue Universelle des Mines, de la Metallurgie, des Travaux Publics, des Sciences et des Arts Appliqués a l'Industrie, March and April, 1874.

Assay of Commercial Sulphate of Soda.—L. L. de Koninck.—Commercial sulphate of soda may contain, besides the normal salt, bisulphate of soda, salts of potash, sulphates of iron, alumina, lime, and magnesia, common salt, water, and insoluble matters. The salts of potash are considered as salts of soda. Free acid includes half the acid of the bisulphate of soda, and all combined with alumina and iron, the whole calculated as SO_3. The sulphate of soda is determined by difference.

Insoluble Matter.—Weigh 50 grms. of the sample, dissolve in 600 to 700 c.c. of distilled water, and filter into a flask marked at 1 litre. The insoluble matter remaining on the filter is washed into the flask, dried, and weighed after incineration. We do not in this manner obtain the full amount of the insoluble matters, since some of them are combustible, and are lost during ignition.

Free Acid.—The filtrate is made up to 1 litre, and well stirred so as to be homogeneous. By the aid of a pipette 300 c.c. are taken, placed in a beaker, and titrated with standard alkali in the usual manner.

Alumina and Oxide of Iron.—200 c.c. of the filtrate are taken, and mixed with bromine-water to peroxidise the iron. Precipitate with ammonia, and weigh the mixed deposit of alumina and ferric oxide in the usual manner.

Sulphate of Lime.—To the filtrate from the alumina and oxide of iron oxalate of ammonia is added. The precipitate is collected on a filter, washed, ignited, treated with a few drops of sulphuric acid, diluted with an equal volume of water, ignited again, and weighed as sulphate.

Sulphate of Magnesia.—To the liquid freed from lime ammoniaco-phosphate of soda is added. The precipitate formed is converted by ignition into pyro-phosphate of

magnesia, 1 part of which represents 1·08 of sulphate. Chloride of sodium is determined by titration in the well-known manner with nitrate of silver, using chromate of potash as indicator. Water cannot be determined directly, for before the water is expelled the bisulphate of soda reacts upon the chloride of sodium. The sample is therefore heated to fusion, and the known amount of free acid deducted from the loss. A correction is still required on account of the loss of hydrochloric acid. For every 117 parts of chloride decomposed by fusion we must add to the loss 25 parts. To find the quantity of chloride thus decomposed, we dissolve the sample after fusion, and re-determine the chlorine.

May and June, 1874.

Experimental Researches on the Laws of Filtration.—P. Havrez.—A mathematical paper, not adapted for abstraction.

Resistance of Phosphor-Bronze, and on its Industrial Applications.—Alphonse Polain.—Two mixtures are given for depositing platinum upon phosphor-bronze. (1) Dissolve 10 grms. platinum in aqua regia, evaporate to a syrup, re-dissolve in 2 litres of water, and add 150 grms. phosphate of ammonia, and 500 grms. phosphate of soda. The reaction of the bath is alkaline. It is heated, without letting it rise to the boiling-point (which would cause the precipitation of the platinum), until the solution has an acid reaction, and all the precipitate is re-dissolved. (2) Dissolve 10 grms. of platinum in aqua regia—

$$(2HCl + NO_5HO),$$

evaporate to a syrup, re-dissolve in 2 or 3 litres of water, add 20 grms. caustic potash and 40 grms. oxalic acid, and heat for five or six hours to 60° or 80° C. The solution becomes clear, and the precipitate is re-dissolved. Potash is then added in sufficient quantity to give an alkaline reaction, when the solution is filtered, and used cold. Two Bunsen elements are sufficient for either mixture.

Note on Phosphoric Steels.—Adolphe Greiner.— Phosphoric steel was first made at Cainsdorf, near Zwichau, Saxony. The crude metal employed contains on an average the following impurities :—

Silicon	2·50
Sulphur	0·04
Phosphorus	0·10 to 0·12
Manganese	2·60 ,, 4·06
Carbon	3·50

Manganese appears to be an antidote to phosphorus. The average composition of the Zwichau steels is—

Silicon	0·40 to 0·70
Sulphur	0·06
Phosphorus	0·10 to 0·15
Manganese	0·40 ,, 0·70
Carbon	0·15

Experience shows that if the phosphorus exceeds 0·20 per cent the steel is too brittle. It seems that phosphoric steels may play a certain part in siderurgic industry, which, however, must not be exaggerated.

Influence of Chlorine upon the Properties of Certain Metals.—C. Kunzel.—The author shows that in nickel, iron, and zinc small quantities of chlorine, say 0·13 per cent, may be the unsuspected cause of failure in working these metals.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the process of obtaining potash from the "yolk" of wool, and from the residuum of the distillation of beet-root juice or of molasses, and in apparatus for the same, which improvements are also applicable to the recovery of soda from the lyes of paper pulp. Hunter Henry Murdock, patent agent, Staple Inn, Middlesex. (A communication from Auguste Louis Joseph Lesage, chemist, Brussels, Belgium.) January 7, 1874.—No. 97. This invention consists of improvements in the treatment in the "yolk" of wool, and the residuum of the dis-

tillation of beet-roots and molasses, in order to obtain potash therefrom, and of apparatus and furnaces for such treatment. The liquor to be operated on is subjected to evaporation by being made to pass through a series of evaporating pans or boilers; it then enters a preparatory furnace, from which it passes into an incinerating furnace in which the potash is obtained. The potash is then removed to a cooling chamber or building, formed on three sides by double perforated walls with an air span between them and closed on the other side by a door, the floor being made of bars or girders, sufficiently far apart to allow of a circulation of air. The first evaporating pan or boiler is mounted above the preparatory and incinerating furnace, and is heated thereby. The incinerating furnace, which is constructed next to the preparatory furnace, is heated by a suitable fire-grate or furnace, which also heats one of the evaporators; a second fire-grate or furnace gives heat to another evaporator, and also consumes the volatile products of combustion from the incinerating furnace, which products of combustion first traverse the preparatory furnace. Other evaporators are heated by separate fire-grates or furnaces. The flues from all the fires open into a terminal flue heating the last of the evaporators, in which flue the products of combustion from the different sources mingle and are consumed.

Improvements in the extraction of quinine from bark. Albert Augustus Deiss, machine maker, Fish Street Hill, London. January 10, 1874.—No. 147. This Provisional Specification describes extracting quinine from bark by a hot process. The bark to be treated is placed in a close vessel, and the vapour of alcohol or other solvent is admitted at the top, and permeates amongst the bark and condenses to form an extract, which runs out at the bottom, from which extract the quinine is obtained.

Improvements in treating sewage-water and other foul liquids. Augustus Edward Schmersahl, manufacturing chemist, Manchester. Lancaster. January 12, 1874.—No. 160. The features of novelty in this invention consist in precipitating all the useful matters in solution or suspension in such liquids by means of a mixture of acids, say 2 parts of sulphuric acid mixed with water, and 1 part of hydrochloric acid, which is added thereto in sufficient quantity to decompose such matters, when milk-lime is added to neutralise the liquid, and the precipitate immediately falls, leaving the effluent water pure and odourless.

Improvements in the method of condensing muriatic acid gas and other fumes. Robert Stirling Newall and Henry Bowman, Washington Chemical Works, Newcastle-on-Tyne. January 13, 1874.—No. 165. The gas is condensed by being admitted into small low chambers, and having injected amongst it water divided into the finest spray, so as to bring the largest surface of water in contact with the gas and produce a rapid condensation.

Improvements in the manufacture of soda in revolving furnaces. William Black, Hedworth, near South Shields, and David Hill, East Jarrow, South Shields, Durham. January 13, 1874.—No. 173. The essential feature of this invention consists in heating the mixture of sulphate of soda, carbonate of lime, and small coal in such a manner as to prevent the formation, as far as possible, of caustic lime: and this may be accomplished by putting the whole mixture of sulphate of soda, carbonate of lime, and small coal into a revolving furnace together, or by heating the carbonate of lime by itself, but stopping short in the heating at that point at which it begins to give off carbonic acid and forms lime, and then adding the sulphate of soda and small coal.

Improvements in the treatment of substances containing alumina, so as to render them more suitable for the production of aluminous compounds. George Archbold, D.Sc., analytical and consulting chemist, Spittal, Berwick-on-Tweed. January 15, 1874.—No. 200. This invention relates to the treatment of substances containing alumina, such, for example, as china clay, so as to render the alumina contained therein more suitable for the production of aluminous compounds and products, and consists in subjecting the substances containing alumina, such as china clay, to a drying process, and when sufficiently desiccated reducing the same to a fine state of division by any well-known methods. The finely-divided clay is then incorporated with spent hops, spent malt, unmalted grain, sawdust, charcoal, or any combustible porous substance, and the mixture is then impregnated or saturated with a hydrocarbon, such, for example, as heavy coal-oil or other economical natural products, or the results of the distillation of carbonaceous materials. The materials so mixed and incorporated are then subjected to the action of heat, either in a reverberatory furnace or otherwise, when it will be found that the aluminous constituent of the clay thus prepared will be more easily attacked by sulphuric and other acids, and that a neutral sulphate of alumina can be obtained therefrom.

Improvements in the manufacture of bichromate of potash. George Smith, chemist, Newcastle, Northumberland. January 17, 1874.—No. 224. The novelty in this case consists in obtaining a more intimate mixture of the chromate of iron ore and alkali by dissolving the alkali before mixing it with the ore, and in the addition of unburnt Irish lime to the compound, and also in the use of carbonate of soda as part of the alkali.

Improvements in the manufacture of white lead. Bernard Charles Molloy, barrister-at-law, Temple, and Desmond Gerald Fitzgerald, electrician, Brixton, Middlesex. January 21, 1874.—No. 266. The essential features of this invention consist in the production of what is known as white lead, carbonate of lead, or basic carbonate of lead, by effecting the decomposition of chloride and of oxychloride of lead by means of an earthy carbonate, or by means of an earthy carbonate in conjunction with an alkaline earth, or the hydrate of the same.

Improvements in the treatment of sewage and ammoniacal liquids. Major-General Henry Young Darracott Scott, C.B., and John Berger Spence, merchant, Manchester, Lancaster. January 22, 1874.—No. 283. The object of this invention is the treatment of sewage and ammoniacal liquids so as to abstract therefrom the ammonia present in a cheap, portable, and stable form. When the liquid to be operated on has been clarified by removing the suspended matters by subsidence or precipitation, we pass the clarified sewage through layers composed of natural phosphate of iron in the hydrated condition, or of phosphate of iron. The phosphate salt or salts are then allowed to subside in combination with the ammonia abstracted from the liquid.

Improvements in the production of tannin and canocarpine. Paul Philippe François Micheá, Leadenhall Street, London. January 23, 1874.—No. 284. This invention relates, firstly, to a process for the production of tannin from tannin-bearing plants, trees, fruits, leaves, barks, or extracts. thereof; and, secondly, to the application of such process to the production of a substance known as canocarpine; a process for the production of which from the leaves of the *Canocarpus latifolia* was described in the Specification to a Patent dated September 20, 1872, No. 2786. The tannin contained in the said plants, trees, &c., is first extracted by decoction or maceration in an aqueous solution of common salt, or in sea-water, or in a solution of sulphate of soda, to which about 1 per cent of a soluble salt of lime or magnesia is added. From the liquid thus obtained the tannin is precipitated by the addition of an alkali or alkaline earth. The tannin compound thus precipitated is washed, and is then suspended in water, and by the gradual addition of a free acid the precipitate is dissolved, and a solution of tannin is obtained, giving all the usual reactions of tannin. For producing canocarpine from the leaves of the *Canocarpus latifolia*, a decoction of the said leaves is subjected to fermentation until the tannin is destroyed, and the fermented liquid is then subjected to the above-described process for the production of tannin, whereby a solution of canocarpine is obtained ready for use as a dye-stuff.

Improvements in the manufacture of anthracen. Ernst Friedrich Richard Lucas, consulting chemist, Coatham, Redcar, York. January 24, 1874.—No. 317. Under this invention anthracen is obtained from the heavy coal-tar oils which distil at from 260° to 360° Celsius, by passing the same, or the vapours thereof, through pipes or retorts previously raised to a red heat. The heated surface is increased by filling the pipes or retorts with pieces of fire-brick. The oil obtained by this operation is submitted to distillation, and the distillate which passes over after 360° Celsius, is collected separately, cooled, and pressed, the press cake thereby obtained being crude anthracen. The liquid oil resulting from this distillation is again passed through red-hot pipes or retorts, and another portion of anthracen is obtained therefrom.

An improved process of bleaching animal glue of all kinds. Antonio Muzzarelli, merchant, 82, Boulevart Sébastopol, Paris. January 26, 1874.—No. 324. This invention relates more especially to glues made from rabbit skins for use in dressing white tissues. When the glue is prepared and decanted into tubs, a solution of sulphate of soda is poured into the moulds, and mixed with a spatula so as to make a uniform mixture. A solution of acetate of lead is then added, which produces a fine precipitate of sulphate of lead; it is then allowed to cool, and the whiteness of the jelly will be proportionate to the admixture of the sulphate or acetate. The glue thus bleached and destined for desiccation is then cut up and dried in the usual manner.

THE CHEMICAL NEWS.

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ON THE DECOMPOSITION OF EGGS.

By WILLIAM THOMSON, F.C.S.

THESE researches were commenced by the late Dr. F. Crace-Calvert and myself about the beginning of October, 1870, and extended over the following year and a half. Many series of experiments were made with the view to ascertain the effects of certain influences on the decomposition or putrefaction of eggs, but in this memoir I shall state the results of our experiments generally.

We found that the contents of eggs, when their shells were intact, could only be decomposed by one, two, or all of three different agencies.

To the first we gave the name of "putrid cell," to the second "vibrio," and to the third "fungus" decompositions.

The first, or *Putrid Cell* is capable of being developed within any egg, no matter how effectually its shell be protected from the introduction of spores from without, or from the diffusion of gases. It is generated from the yolk; in some cases the yolk begins to swell and absorb most of the white; in others the yolk bursts, and its whole substance becomes thoroughly mixed up with the white; and in others, again, it begins to change slightly, and then gives off cells into the white, rendering the white turbid; and in all cases where this ferment takes thorough hold of the albumen, true putrefaction commences, and the albumen emits a putrid smell. The minute granules or cells of the healthy yolk assume, only in some eggs, a morbid vitality; they grow large and become filled with small cells; the large, or parent cell, bursts, and each separate cell then takes an independent existence, which in its turn again follows the same mode of development. This cell appeared to us to be the bioplasm, or cells of the yolk, which, had the egg developed into a chicken, would have gone to form its flesh, bone, and tissues.

Certain gases seem to have the effect of retarding or preventing its growth, such as carbonic dioxide and coal-gas, but oxygen facilitates it. It converts oxygen into carbonic acid. The following experiment may be cited:— An egg was placed in a bottle of pure oxygen on the 8th of March, 1872, and examined on July 5th, 1872 (after 118 days). The bottles used for these experiments were of 18 ounces capacity, fitted with large firmly-fitting india-rubber corks, from which the eggs were supported by wires. Each had two tubes penetrating the corks, the one going to the bottom of the bottle, the other merely penetrating the cork. When the egg had been introduced, the bottle was taken mouth downwards, and oxygen passed into it by the longer tube, making its exit, accompanied with the air previously present, by the shorter one. After passing the gas for twenty minutes, a little was passed direct from the bottle into an eudiometer and analysed, and found to contain 99·75 per cent of pure oxygen. The exit-tube from the bottle was then hermetically closed at the blowpipe, while the gas was yet passing; the entrance-tube was then hermetically closed, and the bottle placed mouth downwards under water. At the expiration of 118 days no water had penetrated the cork; the bottle was placed mouth downwards under mercury, the end of the shorter tube broken off, and joined to a tube and reservoir filled with mercury, by a piece of india-rubber tube, so that, by turning the tap, mercury was allowed to flow down and gradually fill the bottle from the bottom, and thus displace the gas, through the longer tube penetrating the cork into the gas tubes. On analysis, this gas gave—

Oxygen	0·20 per cent.	
Nitrogen, &c. ..	4·74	,,
Carbonic dioxide ..	95·06	,,

100·00

The egg, on examination, was found to be decomposed entirely by "putrid cell," and no other germ of decomposition could be found by the microscope. The yolk had expanded and was thoroughly mixed up with the white, and the contents emitted a bad, putrid smell.

To observe whether this "putrid cell ferment" would penetrate the shell, some eggs were placed in water, to which was added the half of the contents of an egg which had been attacked by that ferment. A series of experiments of which this formed part was commenced on August 8th, 1871, in which other lots of eggs were placed in water containing different agents of decomposition; in one or more of the eggs from each of these lots in the series, the "putrid cell" developed, but those immersed in the water containing the "putrid cell" were all attacked by it after 100 days. This ferment, however, does not prevent the development of animalculæ; for within fifteen days from the commencement of the experiment a number of vibrios had made their appearance, besides a large number of animalculæ, which resembled cork-screws, whose bodies were rigid and formed of from one-and-a-half to two turns of the screw; these animalculæ swam quickly about by turning quickly round on the same principle that a cork-screw penetrates a cork. Two more species of animalculæ also developed simultaneously with these screws; they resembled flukes—some possessed one long filament or feeler, and some two, about three times the length of their bodies, and these animalculæ swam about by means of these filaments, which were switched quickly into a serpentine motion before them. It was remarkable, however, that the ordinary vibrios and the putrid cells were the only agents of decomposition which succeeded in penetrating the shells of the eggs and developing within them. The fluke and screw animalculæ never succeeded in making their way through the shell of any egg which came under our observation, although at different times we examined many which lay in fluids swarming with them for months.

I may just mention, *en passant*, that the germs of the screw and fluke before mentioned seem to exist on the outside of the shell, and in no case did we discover their presence among the germs which float in the atmosphere. When the fluke alone takes much part in the decomposition of any albuminous solution, it turns it to a pale green colour and emits an intensely putrid odour, but the screw, on the other hand, emits but little smell.

Decomposition by the agency of Vibrios.—This decomposition is brought about by an animalcule like a worm, which always appears quite straight, sometimes swimming about, and sometimes moving to and fro, or apparently dead. These vibrios are of different sizes, consequent upon their peculiar mode of development, described in one of the papers on protoplasmic life by the late Dr. Crace-Calvert. The long vibrios at first produced divide into two shorter ones, which again sub-divide in the same way, producing four still smaller, and so on till they arrive at the stage of swimming dots, which lastly lose their power of swimming and merely move to and fro. In this state we term them monads, which appear to be the germs of other vibrios, because when they are put into fresh albumen solutions they produce long vibrios, which again follow the same course of sub-division.

These vibrios and their germs exist in large numbers in the atmosphere, so that water or any organic fluid exposed to the air for a few days, especially in summer, becomes contaminated with them, and thus commences a process of putrefaction in organic fluids.

These animalculæ are often found in the contents of whole eggs which are therefore in a more or less advanced state of decomposition; but we have ascertained, by innumerable observations, that their germs do not exist in the egg

originally, but in all cases penetrate the shell from the outside after the egg has been laid.

Whole eggs that remain dry, exposed to the atmosphere for any length or time, are never attacked by this germ of putrefaction; but if the outside of the shell becomes wet or moist, the vibrios floating in the atmosphere fall on it, develop in the moisture on the outside of the shell, then penetrate it, and develop in the contents. In a series of experiments already referred to, we placed six eggs in water alone (completely immersed), and six in water to which had been added some putrid albumen teeming with vibrios; in the former, vibrios had penetrated the shells, and were developing in the contents of the egg within ten days, and in the latter within six days.

I may here refer to another part of this series, where six eggs were immersed in water to which had been added the contents of an egg undergoing putrefaction by the putrid cell ferment. Screw animalculæ were soon developed in this fluid in large numbers, and these much retarded the development of vibrios, which were not found in the eggs contained in this fluid for some time after they had penetrated the shells of those placed in pure water alone, and in those lying in the water containing putrid albumen. It is impossible for the screw animalcule to make its way through the shell into the contents of a whole egg, but they seem to exhaust the fluid of the oxygen it contains, and thus prevent the growth and development of the much smaller vibrio; so that the eggs in this fluid were comparatively fresh when those in the other two fluids above-mentioned were quite putrid. Fluke animalculæ, when they increase in large numbers in any fluid containing vibrios, have also the effect of greatly impairing their vitality. In one experiment, where a drop of a solution containing fluke animalculæ was added to a fluid swarming with vibrios life, the flukes increased in number with remarkable rapidity, and within a fortnight from thirty to fifty could be observed swimming about under each field of the microscope. The vibrios, which at first swam about with much energy, had now lost all power of motion and appeared quite dead, being swept about by the currents produced by the swimming of the much larger flukes.

These vibrios absorb, or breathe in, oxygen, and liberate carbonic acid, and, to show how necessary oxygen is to their subsistence, we took a solution of albumen, prepared by mixing the white of an egg with pure distilled water (distilled in an atmosphere of pure hydrogen); to this solution we added a drop of a fluid swarming with vibrios, mixed it up well, and transferred the fluid to a long tube, with other smaller tubes joined from the side of it, so that part of the fluid could be drawn from the top, middle, and bottom. After this fluid had stood for some days, a little of it was drawn from the top, middle, and bottom of the tube; the top was swarming with vibrios, the middle contained two or three under each field of the microscope, and at the bottom few or none could be observed. We found, further, by enclosing eggs in different atmospheres of gases where the shells of each were kept wet, that carbonic acid gas and coal gas seemed to have a poisonous effect on the vibrio, and prevented any from penetrating the shell; that nitrogen and hydrogen allowed a few to penetrate it, which, however, had little or no vitality, and could evidently not increase in number; whilst in oxygen the contents of the egg was soon attacked by myriads of vibrios, which rendered it completely putrid; and after thirty-five days, the pure oxygen in the bottle at the commencement of the experiment had been much changed, and gave, on analysis—

Carbonic acid gas	62·00	per cent.
Oxygen	34·30	,,
Other gases (principally nitrogen)	3·70	,,

———

100·00

As a comparison with this, another bottle, filled with pure oxygen, contained a dry egg; after the lapse of

thirty-five days, the gas in the bottle was analysed, and gave—

Oxygen	99·46	per cent.
Other gases	0·54	,,

———

100·00

The egg contained in this gas was quite healthy and free from any germs of putrefaction.

The last experiment which I shall mention of this series is one where the dry egg was pierced by a needle and placed in dry oxygen; here, however, the egg was decomposed by vibrios, and the oxygen largely converted into carbonic dioxide.

Fungus Decomposition.—The fungus which we have found to act principally on eggs, is the *Penicilium glaucum*. The spores of this fungus exist to a large extent, floating about in the atmosphere. If whole eggs be placed in a position subjected to a constant draught, there will be a very small percentage of them attacked by this fungus; but if, on the other hand, they be left in a stagnant atmosphere, the floating spores will soon settle on the shell and begin to develop, sending long fibres or filaments through the shell into the contents. These filaments branch about in immense numbers in all directions, twisting and twining into each other among the contents, so as to become in some cases a dense mass, having the consistency of cheese. In some cases of decomposition by this means we have found the egg to appear as if it had been completely coagulated by cooking; the white appeared to be quite as solid, but more transparent. In some cases, the filaments have not been produced in sufficient quantities to completely coagulate the white into a hard mass, but have crossed from one side of the egg to the other in all directions, and made the white appear like jelly. When eggs are attacked by this means, it is necessary to cut the egg through the middle by a sharp knife to examine its contents, as all sides of the shell are so firmly bound to each other by the filaments, that the whole shell would require to be torn to pieces if the usual method of opening were resorted to.

This spore differs from the vibrio in its being able to penetrate the dry shell of the egg as well as the moist or wet shell. When an egg is attacked by it, its shell is often more or less sparsely coated with a fleece of filaments covered with white spores. These white spores are seldom found within the egg, and they are only produced in presence of a copious supply of air or oxygen. Part of the semi-transparent coagulated mass formed by the filaments of this fungi was cut from the white of an egg, and exposed freely to the atmosphere. Within twenty-four hours a faint white excrescence was observed, which the microscope showed to be a development of spores on the filaments; and in a few days more, the outside of the piece was completely white through the growth of these globular white spores.

In some cases a scanty growth of these filaments with their spores takes place on the outside of the shell, but none penetrate into the contents. In these cases it is remarkable to notice that the shell remains quite smooth; but if, on the other hand, the shell be penetrated by the filaments it feels rough or sandy—produced by the growth of the filaments breaking out little particles of the calcareous matter of the shell.

The growth of this fungi is entirely prevented in an atmosphere of carbonic dioxide. In the gases hydrogen and nitrogen, a few fine filaments of the penicilium were observed to grow from the outside shell, but none penetrated into the contents. In oxygen, however, the growth was most luxuriant in every way.

This fungi acts upon oxygen, converting it into carbonic dioxide; and at the same time it seems to unfold the albumen, liberating nitrogen. This has been shown by several analyses of the gases resulting from keeping eggs for some time in closed atmospheres of oxygen. I shall refer, however, only to one analysis of the gas. A series of experiments were commenced on the 8th of March,

1872; the gases analysed and the eggs examined on the 5th of July, 1872. The atmosphere in the bottle, which at first was ascertained to be pure oxygen, now contained—

Oxygen .. .. 48·06 per cent.

Nitrogen and other gases} (principally nitrogen) ..} 10·15 ,,

Carbonic dioxide.. .. .. 41·79 ,,

           ————

           100·00

The egg on examination was found to be decomposed to a large extent, and by no other agent than the *Penicilium glaucum*.

We ascertained that eggs when pierced by a needle, and laid in a box of loose damp straw, were attacked by this fungi with facility; but many thus left were attacked both by vibrios and fungi, and some were attacked by all three agents of decomposition.

Lastly; having observed that chlorine and chlorides seemed to facilitate the growth of this fungi, we placed an egg in a bottle of common air, and passed into it a little chlorine gas on the 18th of April, 1871. Up till the 12th of December, 1871, no filaments of fungi appeared on the shell. We then opened the bottle, and replaced the cork loosely. On looking at it again on the 19th of December (seven days after opening the bottle) the egg was covered with a thick fleece of white filaments of the fungi, the filaments reaching from 1 to 1½ inches from the shell. This was the most remarkable case of growth of this fungi on the outside shell ever observed by us.

    Royal Institution,
Manchester, Sept. 15, 1874.

A FURTHER STUDY OF THE ANILINE DYES.
By S. E. PHILLIPS.

In a study of saffranine relations (CHEMICAL NEWS, vol. xxviii., p. 116), we thought it well to lay some stress on the probability of their being cyano-diamines; nor do we in this parallel effort at all seek to weaken the force of those considerations which are undoubtedly valid and chemically congruous; but, as the subject is far from being a settled one, we make a kindred effort from another point of view. If the first was one-sided—nor did we pretend it to be any other—let this also be understood as a similar glance at synthetic principles which, if more novel, are not the less chemically valid and instructive to observe.

The accepted truth of some future day will, in all probability, include both points of view; but for the moment our concern is only with the latter.

A generic formula has been projected, by which three amides − 6H produce one of the condensed and tinctorial tri-amides in question, a kind of nitrile condensation; and, conversely, another has been mooted, by which rosaniline + 2HO reverses the process and gives a diamide and H_3N. This diamide + 2HO gives a monamide and H_3N; and, finally, another + 2HO gives rosolic acid or some such body, eliminating the last atom of ammonia!

Now the generic process involved in this − 2H or 2HO, and its inverse + 2H or 2HO, will be found to cover a very large proportion of organic reactions; and the tendency is *one*, whether it be 2H of a hydride or 2HO of an oxyhydrocarbon.

It is *apropos* to observe that we have pointed out a new feature of this reaction, in the beautiful ammonia gluco-side condensations of M. Schiff, where every additional condensation of aniline or ammonia, in the atom, is attended with the elimination of 2HO from the glucoside radical (see CHEMICAL NEWS, vol. xxvii., p. 200).

Æsculetine, $(C_{18}H_5O_6)O + HO$, and aniline − 2HO =
                $(C_{18}H_5O_6)PhHN.$

,,   ,,   ,,   and 2 aniline − 4HO =
                $(C_{18}H_3O_4)Ph_2H_3N_2,$

,,   ,,   ,,   and 3 aniline − 6HO =
                $(C_{18}H_1O_2)Ph_3H_4N_3.$

This is only one phase of "*minus* 2HO." In an extended study of urea derivatives, we have found that it very often means a cyano production.

    Let An = aniline, $C_{12}H_5 H_2N.$

    ,,   To = toluidine, $(C_{14}H_7)H_2N.$

    ,,   Xy = xylidine, $(C_{16}H_9)H_2N.$

    ,,   Na = naphthaline, $(C_{20}H_7)H_2N.$

Violaniline, $C_{36}H_{15}N_3 = 2An + An - 6H =$
                $(C_{12}H_3)_3H_6N_3.$

Mauvaniline, $C_{38}H_{17}N_3 = 2An + To - 6H =$
                $(C_{12}H_3)_2C_{14}H_5H_6N_3.$

Rosaniline, $C_{40}H_{19}N_3 = 2To + An - 6H =$
                $(C_{14}H_5)_2(C_{12}H_3)H_6N_3.$

Chrysotoluidine, $C_{42}H_{21}N_3 = 2To + To - 6H =$
                $(C_{14}H_5)H_6N_3.$

Magdala, $C_{60}H_{21}N_3 = 2Na + Na - 6H =$
                $(C_{20}H_5)_3H_6N_3.$

Xylidine red, $C_{44}H_{23}N_3 = 2Xy + An - 6H =$
                $(C_{16}H_7)_2(C_{12}H_3)H_6N_3.$

Another red, $C_{52}H_{19}N_3 = 2Na + An - 6H =$
                $(C_{20}H_5)_2(C_{12}H_3)H_6N_3.$

Perkin's red, $C_{40}H_{15}N_3 = 2Na + H_3N - 6H =$
                $(C_{20}H_5)(C_{20}H_3)H_7N_3.$

Leucaniline, $C_{40}H_{21}N_3 = 2TO + An - 4HO =$
                $(C_{14}H_5)_2(C_{12}H_5)H_6N_3.$

Chrysaniline, $C_{40}H_{17}N_3 = 2To + An - 8HO =$
                $(C_{14}H_3)_2(C_{12}H_5)H_6N_3.$

The great difficulty herein is the tardy recognition among modern chemists of the nitrile radicals with diminished ratios of H, and this is the more surprising as they deal so largely with ethylens and other nitrile hydrocarbons of diatomic or triatomic properties, of whose existence there is probably no evidence whatever extant.

As ethyl − 2H gives (C_4H_3), and that by a similar action gives (C_4H_1), so the higher ratios of carbon give their corresponding nitrile or other radicals.

In chelidonic acid we have long recognised the ratio of $C_{14}H_1$. In succinic and tartaric acids we have the ratio of C_8H_3 and fumaric C_8H_1. Cernenic acid is $(C_{12}H_1O_6)O + 3HO$, and phthalic acid $(C_{16}H_3O_4)O + 3HO$.

In sundry so-called mellitic derivatives we have several cases of $C_{18}H_1$ or $C_{18}H_3$, and $C_{20}H_1$ or $C_{20}H_3$, &c. In all such cases there is, doubtless, a strong tendency to evince oxy-ratios, but these are matters of varied degree, and the simple hydrocarbon radicals do most undoubtedly exist under extreme reactions.

Aldehyde, by long digestion with ammonia, gives $(C_4H_3)H_2N - (C_4H_3)_2HN$ and $(C_4H_3)_3N$ and further condensations! I cite these cases as against the many attempts to regard this radical as (C_4H_4) and diatomic.

We have nicotine, $(C_{10}H_5)H_2N$, and Miller speaks of a new base from kreatine, evidently the nitrile $(C_6H_3)H_2N$; and in taking a wide survey of such bodies, and making full allowance for cyano-isomers, there yet remains a very large group, where the normal 2 vol. ammonias, with their well-marked *basic* habitudes, proclaim their distinctive characters.

As we can now distinguish between the isomers $(C_{14}H_7)Me_2N$, or $(C_{16}H_9)MeHN$, or $(C_{18}H_{11})H_2N$, so some future Hofmann will enable us to identify the real character of these tinctorial radicals; but, in the meantime, all these notations are only offered in a *pro tem.* sense, or provisionally.

We say 2 crotonic aldehyde + ammonia − 4HO = aldehydine, $(C_8H_5)_2HN$, but it may be an isomer of the well-known $(C_{16}H_9)H_2N$!

With this *emphatic* proviso, we conclude this notice with a few azo and other kindred bodies where cyano tendencies are undoubtedly paramount and perplexing:—

Azo-naphthaline, $(C_{20}H_5)_2H_4N_2,$

Azo-toluide, $(C_{14}H_5)_2H_4N_2.$

Carbazol, $(C_{12}H_3)(C_{12}H_5)HN.$

Azo-oxybenzide, $(C_{12}H_5)(C_{12}H_3O_2)H_4N_2,$

Diphenine, $(C_{12}H_7)(C_{12}H_3)H_4N_2,$

Azo-benzol, $(C_{12}H_5)_2H_4N_2,$

Hydro-benzol, $(C_{12}H_3)(C_{12}H_5)H_4N_2$.

Ethylen-diamine-sulpho-carbonate, $(CS)_2(C_4H_5)H_3N_2$.

Ethylen - sulpho - carbamide, or ethylen - sulpho - urea, $(CS)_2(C_4H_3)H_3N_2$.

Hydro-sulpho-cyanate of ethylen-diamine,
$$(CS)_4(C_4H_3)H_7N_4 \, (?)$$

Ethylen-dibenzoyl-diamide, $(C_4H_3)(C_{14}H_5O_2)_2H_3N_2$.

Ethylen-diformyl-diamide, $(C_4H_3)(C_2H_1O_2)_2H_3N_2$.

In the " good time coming " we may hope for more consistency in nomenclature, for simpler names, and clearer types.

In the transition state, we may eclectically regard opposite views, and know that the clash of opinions promotes the acquisition of ultimate truth.

PROPAGATION OF PRESSURE AND FLOW OF WATER IN LONG TUBES.

A LEAD pipe 3000 metres long and 7 m.m. wide, which M. Oskar Mayer had obtained for some other experiments, afforded a good opportunity for making observations on an extensive scale, on the propagation of pressure and flow of water in cylindrical tubes. The entire length of pipe was made up of 12 rolls, each of 250 metres length. At either end was a force-pump, by which the pipe could be filled with water. The air was allowed to escape through fine holes at the highest point, which were afterwards closed. Further, one end of the pipe was connected with a mercury manometer, the scale of which reached to 5 atmospheres pressure.

" In a first observation, made with this apparatus, I determined the velocity with which pressure was propagated through the entire length of the pipe. According to the principles of the wave theory, it cannot be doubted that the velocity with which a single impulse of pressure is propagated, must be no other than that with which a series of impulses in slow or quick succession is propagated; that is, no other than the velocity of sound.

" The velocity of sound in water (unconfined) is in round numbers, 1400 metres in a second. Wertheim, however, has shown from observation of the tones given by pipes filled with water, that in narrow tubes the velocity is considerably smaller; it only reached 1100 to 1200 metres in his experiments. Considering that in the narrow pipe now used, the motion must be still more retarded through friction, the velocity of sound in it could not be expected to be more than about 1000 metres in a second; so that the entire length of tube would be traversed in 3 seconds.

" This expectation was quite verified in experiment. A sudden pressure of the piston of the pump at one end of the tube produced an effect in the manometer at the other end in exactly 3 seconds.

" In a long series of observations I investigated the laws of the velocity with which water flowed through this long and comparatively narrow tube.

" Of the law governing the flow of water through cylindrical tubes, we have exhaustive knowledge only for the particular case in which the tube is very narrow, a capillary tube, and one of considerable length. This has been studied experimentally by Poiseuille, G. Hagen, H. Jacobson, and others.

" For the case of water-flow through wide tubes, interpolation formulæ have in general been constructed. Only two recent works, one by G. Hagen, the other by C. J. H. Lampe, have aimed at reducing the more complicated laws for wide tubes to the simple form of the law for capillary tubes. Hagen has perfectly succeeded in proving that the same formulæ, through which he represented his own experiments with capillary tubes, also include the law of the measurements made by Darcy on wide tubes.

" With still greater probability might I anticipate a good agreement with Poiseuille's law, in observations with a narrow tube only 7 m.m. diameter. The apparatus was so far altered that the pipe was cut off before one of the

force-pumps previously used; the pump at the other end, however, and the manometer beside it being retained. By quick and short motion of the handle of this pump, the mercury in the manometer could be maintained nearly in the same position, while at the other and open end of the pipe, the water flowed out by a regular velocity. The time was observed in which half a litre of water flowed out through the 3000 metres pipe, and this was repeated with varying pressures of the manometer. The temperature of the water was about 96° C.

" Two days later the same experiments were made with shorter portions of the pipe, which was cut through for the purpose. The temperature of the water was 11° C."

The values obtained were utilised for construction of a formula for the flow of water, and they led to the result that Poiseuille's law holds good for outflow of water, not only through capillary tubes, but also through wider, where these are sufficiently long. It was found confirmed for a tube 7 m.m. wide, and 2500 to 3000 metres long. A correction, however, was required.—*Poggendorff's Annalen, Jubelband.*

CRITICAL NOTES UPON THE

ALLEGED NUCLEAR ACTION OF GOLD
UPON
GOLD REDUCED FROM SOLUTION BY ORGANIC MATTER.*

By W. SKEY,

Analyst to the Geological Survey of New Zealand.

IN a paper upon the formation of gold nuggets which appeared in Part I., vol. viii., of the *Transactions and Proceedings of the Royal Society of Victoria*, the author, Mr. C. Wilkinson, states in reference to ths question as to the origin of gold nuggets that " Mr. Daintree, formerly of our geological survey (that of Victoria) had on one occasion prepared for photographic use a solution of chloride of gold, leaving in it a small piece of metallic gold undissolved. Accidentally some extraneous substance, supposed to have been a piece of cork, had fallen into the solution, decomposing it, and causing the gold to precipitate, which deposited in the metallic state, as in the electro-plating process, around the small piece of undissolved gold, increasing it in size to two or three times its original dimensions."

The results alleged to have been obtained by Mr. Daintree appearing to have, and indeed being recognised as having, a very important bearing upon the popular question as to how our gold nuggets have been formed, I have endeavoured to obtain further details, but in this I have been unsuccessful. Mr. Brough Smyth, indeed, in his work upon the Gold Fields and Mineral Districts of Victoria, refers to what appears to be the same experiment, but nothing further is there stated except that the size of the gold fragment started with is increased from a " speck " to a " piece." I have therefore tried to reproduce the results themselves, and having been unsuccessful, I will describe minutely the several modes I adopted.

1. 0·1315 gramme of gold, hammered thin, and bent to a curved disc of such a size as to expose about half a square inch of superficies, was placed in a glass vessel containing two ounces of a solution of auric-chloride of a strength equal to half a grain of gold per ounce. For reducing agents small pieces of cork and wood were sunk by glass attachments to the bottom of the vessel in close proximity to the disc of gold.

The vessel was then closed, put in a darkened place, and suffered to remain at rest until all the gold present in solution had been reduced, a process occupying in this case a period of time equal to rather more than two months.

* Read before the Wellington Philosophical Society,

The gold disc was then carefully examined and weighed. It had a small quantity of very finely granular gold loosely adherent to it, and apparently equally disposed over its surface.

With the whole of this loose gold attached the disc only increased in weight 0·0005 of a gramme, or 1-263rd of its weight (a rate of increase that would require about forty-four years to double the size of the disc), consequently only about the 1-130th part of total amount of gold present in solution had deposited upon the disc, the remainder having deposited away from it, and this was seen to have indiscriminately attached itself to every surface which had contact with the auriferous solution, whether the bottom or sides of the vessel, the glass attachments, or even the surface of the liquid having contact only with the atmosphere.

In reference to the minute quantity deposited upon the gold disc it was found by numerical calculation that the proportion was certainly not more, relatively to the surface of the disc, than that which the remainder of the gold bore to the extent of the surfaces upon which it had affixed itself.

2. The same experiment repeated, but vessel and contents not darkened. Same results as before.

3. Gold solution reduced to half its strength, and time of total deposition extended to four months. Diffused sunlight admitted.

4. Soluble organic matter used in place of wood; sunlight excluded. Time of total deposition of gold two months.

No discernible difference in results upon point in question to those obtained in experiment No. 1.

So far, therefore, as is shown by these results, gold reduced from solution of its chloride by aid of such kinds of organic matter as cork or wood, does not in the manner of its deposition exhibit such a notable selective power for metallic gold as the description of Mr. Daintree's results would lead us to suppose. It does not, indeed, show any such selective process at all, that is, to a greater extent than can be attributed to the action of surfaces generally regardless of their nature; and in support of this, I believe I am correct in stating that the whole sum of our experiences (omitting those of Mr. Daintree) is directly against this theory, as to the rapid and marked deposition of gold on gold in the manner stated; indeed, so far as I am aware, we only produce by these means fine incoherent powder—minute crystals or films of exceeding thinness—nothing nuggety. We get a certain size of grain or crystal, or a certain thickness of film, which our efforts have hitherto failed to enlarge.

Our experience therefore on this point being in such opposition to that of Mr. Daintree quoted above, and which he quiescently allows to be imputed to him, and the subject itself being a most important one, it does seem that the data upon which these apposite statements are founded should be ample, of a definite character, and clearly stated; but so far it does not appear by any means certain, from all I am able to gather on the subject, whether there was in reality any notable deposition of gold on the undissolved residue of gold, and if so, whether the reduction of this gold was solely effected by agency of organic matter. Thus Mr. Wilkinson states, "Accidentally some extraneous substance, supposed to be a piece of cork, had fallen into the solution, decomposing and precipitating the gold." Here then we are led to suppose that the vessel containing the solution, &c., was not closed. What, therefore, might not be reasonably supposed to have fallen in besides cork, or any other kind of organic matter? Pyritous dust, or even a small nugget of this substance, might have accidentally fallen in this solution, splintered off from some specimen which perchance Mr. Daintree himself might have been examining; pyritous matters generally being able, as I have shown, to reduce gold from such solutions, and to deposit it indefinitely upon gold or other electric conductor, Unless

precautions had been taken, therefore, to prevent the introduction of reducing agents other than those coming under the description of organic matter, it is impossible to credit the latter with producing the phenomena described. But granting that nothing except organic matter was administered to the solution, even then the evidence as to the enlargement of the "piece of undissolved gold" is exceedingly unsatisfactory.

Thus it appears from the manner of stating the matter that neither the weight nor volume of the "undissolved gold" was determined, the apparatus, &c., evidently not being arranged for any experimental inquiry at all. If then no such determinations were made at the outset, they would be of no value as applied to the piece of gold after the process of decomposition was complete. Consequently the statement that the undissolved gold was increased two or three, or several times, its volume, as Mr. B. Smyth states, is guess-work, for the correctness of which we are dependent upon the power of the eye to realize size, the power of the memory to retain a correct and distinct impression as to the size and shape of the gold piece at the outset, and, further, upon the proper working of the comparative faculty, in order that this image in the memory may be correctly compared with that which the enlarged nugget presented to the eye when the process was finished.

Obviously so many delicate processes are involved in this method of estimating size, that the results given cannot properly be taken as being absolutely correct, nor yet even to have such weight as to induce us to forego our present belief in the dispersion rather than the aggregation of gold precipitating from solution under the circumstances stated.

In the meanwhile, in cognisance of the tendency of gold to scatter when reduced from solution by organic matter, as manifested by my experiment here described, and by our previous experience in this matter, and on the other hand its tendency to agglomerate when reduced from solution by metallic sulphides, I cannot allow Mr. Daintree's results, as at present known to me, to affect me in any speculations I may make as to the origin of gold nuggets in drift.

ON THE PRECIPITATION OF ZINC BY WATER.

By J. L. DAVIES.

ZINC may be added to the list of metals which can be precipitated by means of water. The conditions seem to be these—if to a solution of zinc chloride just sufficient *only* of ammonia be added to re-dissolve the precipitate at first formed, the addition of water throws down zinc in the form of a gelatinous and bulky precipitate. In the cold the whole of the zinc is not thus precipitated, but possibly with continued boiling it might be.

Hafod Ishu Works, Swansea.

NOTICES OF BOOKS.

Elements of Metallurgy; a Practical Treatise on the Art of Extracting Metals from their Ores. By J. ARTHUR PHILLIPS, M. Inst.C.E., F.G.S., F.C.S., &c. London; Charles Griffin and Company.

METALLURGY was an art long before it became a science. By hard-earned experience man acquired considerable skill in the practice of certain metallurgical operations, whilst profoundly ignorant of the principles upon which his operations were based. It is one thing to know empirically how to effect a certain result; it is quite another thing to know rationally why that result is effected. In these days, however, the old method of working by mere rule-of-thumb, has given way in most cases to a more

enlightened system, in which the metallurgist gladly seeks the aid of the chemist, and applies the principles of chemical science to the practice of the smelter's art. It is true that no amount of mere scientific knowledge will make a man competent to undertake metallurgical operations; but on the other hand it is equally true that no amount of mere experience at the furnace will enable him to intelligently understand the operations which he daily conducts. The metallurgist needs, indeed, a happy union of practical knowledge with scientific training. Such a combination of experience with theory is fortunately possessed by the author of the work under review, who is consequently fitted in a marked degree for the task to which he has addressed himself in the present volume.

At once an experienced metallurgist and a sound chemist, Mr. Phillips writes upon the smelter's art with the authority of one who has had, in many cases, daily familiarity with the operations he describes; whilst he interprets the meaning of these operations by the light of our most advanced science. Within the compass of a single octavo volume, he leads the student over the whole range of metallurgical science, and judiciously touches upon almost everything that is worth mentioning, whilst avoiding the description of such processes as are either useless or obsolete. Many of the descriptions are based solely on original observation; such for example as that of lead, smelting at Pontagibaud, and of the wet process of copper-extraction so largely applied in this country to the treatment of burnt pyrites. Equally clear descriptions of these and some other processes are not to be found elsewhere.

After an introductory chapter in which the author traces briefly the history of metallurgy, he attacks the main subject of his volume, and commences with a description of the various physical characters of the metals—their colour, opacity, lustre, hardness, specific gravity, crystallisation, malleability, ductility, tenacity, fusibility, conductivity, volatility, and what not. This is followed by a discussion of the characters of the different kinds of fuel—wood, peat, lignite, coal, charcoal, and coke—including a notice of gaseous fuel, which of course introduces us to a description of Siemens's furnaces. Another chapter is devoted to fire-clays and other refractory materials, and their application to the manufacture of crucibles and fire-bricks. Each metal is then described in detail, commencing with iron, as the most important commercially, and continuing the series in the following order:—cobalt, nickel, aluminium, copper, tin, antimony, arsenic, zinc, mercury, bismuth, lead, silver, gold, and platinum. Under the description of each metal we find an account of the ores which yield it, the methods of assaying these ores, and the details of their metallurgical treatment. The processes are described in extremely clear language, and are illustrated by unusually good engravings; in fact, we may point to some of them, such as those of the Ayrsome kiln-hoist, as admirable examples of wood-engraving. The illustrations are mostly drawn to scale, and are, in the majority of cases, taken from original drawings. Particular attention has been paid to the collection of trustworthy statistical information which has been brought as far as possible up to date.

We consider that Mr. Phillips deserves well of the metallurgical interests of this country for having produced a work which is equally valuable to the student as a text-book and to the practical smelter as a standard work of reference.

CORRESPONDENCE.

VALUATION OF PHOSPHATES.

To the Editor of the Chemical News.

SIR,—Can any of your readers explain a statement made by Dr. Voelcker in his annual report to the R. A. Society (*Journal of the Royal Agricultural Society*, vol. x. part 1,

p. 281), that soluble phosphate can be bought at 3s. 6d. per unit—that is, according to my calculation £7 10s. per ton. I use a large quantity of superphosphate, and always buy it by analysis, and I calculate its value from the rule given by Dr. Anderson in his "Agricultural Chemistry," where soluble phosphate is set down as £30 a ton or 6s. a unit, very nearly twice as much as Dr. Voelcker's estimate. If this latter is correct I have been paying far too much for my manures, and I should be very much obliged for an explanation or by a reference to any book or books that will help me to clear the matter up. Dr. Voelcker, I see, in a paper published ten or twelve years ago, values soluble phosphates at £30 per ton. Has its value decreased lately?—I am, &c.,

A GLOUCESTERSHIRE FARMER.

DOUBTFUL MINERALS.

To the Editor of the Chemical News.

SIR,—The following is a list of minerals of very doubtful character. No minerals bearing these names are to be found in the British Museum. Mineral dealers do not keep them in stock; and yet they persistently keep their places in our mineralogical books. Many of your readers, no doubt, rub up their mineral knowledge occasionally, and find the changing nomenclature sufficiently irritating without the additional nuisance of having to drag year after year this dead log of disgusting old acquaintance, whose sudden death it is not at all sinful to wish. To effect this has been the difficulty. It has struck the writer that if you will kindly assist as executioner by publishing the list of offenders, the deed may be done. These 150 useless dogs have gone unhung long enough. Invite your friends to the *battue*. The books tell us rightly or wrongly their composition. We don't want to be re-told that. The knowledge we want is—whether the things so named exist at all? or if they do exist, by what names are they now called by those who possess them?—I am, &c.

T. A. R.

Liverpool.

Acanthoide	Claussenite	Erythonium of De
Acnite	Clayite of *W. J.*	Rio
Acrusite of *Ger-*	*Taylor*	Eschwegite of
hard	Conichrite of	*Dufrenoy*
Alm	*Thomson*	Euphotide-Jadien
Almagierite	Conistonite	of *Brogniart*
Alumina, Native	Copper, native sul-	Euphotide of the
Amausite	phide	Alps
Anchosine	Copper, pitch-	Ferrite
Apatoid	blende	Fossil Caoutchouc
Beaumontite of	Coulobrasine and	and Carbon
Jackson	Crucite of *Thom-*	Gibsonite of *Haid-*
Belonite of *Glocker*	*son*	*inger*
Bismuthaurite	Cryptolinite	Grahamite
Blakeite of *Dana*	Culebrite	Granatine of *Her-*
Bombite of *Les-*	Cyanolite of *How*	*mann*
chenault	Delarnite	Halloyvite of St.
Bottle stone of	Delawarite of *Lea*	Jean-de-Cote
Moravia	Deliminozite	Hartine (? Xylore-
Breadalbanite	Dipyrite	tine)
Bucaramangite	Dopplérite of	Heddlite
Caliche of *Thom-*	*Deicke*	Helvetan of *R. T.*
son	Dumasite of	*Simmler*
Caliphite of *Thom-*	*Delgre*	Herrerite of *Her-*
son	Dyripe of *Thomson*	*rera*
Canoxinite of *Bis-*	Dyslytite of *Shep-*	Hessenbergite of
chof	*ard*	Hydrocalcite
Calalina stone of	Ephesite of *J. L.*	*Dr. Krautz*
Newfoundland	*Smith*	Hydrohalite
Chionit	Epiphosphorite of	Hydrophillite
Chromochlorit of	*Breithaupt*	Hydrosilicate
Thomson	Erusibite of *Shep-*	Hystatique
Chytophyllite	*ard*	*Breithaupt*

Idryl of *Bodeker*	Metaxorite	Scoritite
Ioguneitof *Nordenskjold*	Molybdanuran	Scotine
Jason of *Jameson*	Mourolite	Selenpalladite
Kabook of Ceylon	Nepaulite	Serpentinite
Kalicine of *Pisani*	Nickelthoneisen-zinksilicat	Sexangulites of *Breithaupt*
Kalkoolborthite	Nitramite	Siderographite
Keityoit	Nitromagnesite	Siderorbole
Kieselguhr	Oriental Garnet	Silbeloit
Kimbleit	Oro Pudre	Skorilite
Kensigite of *Fischer*	Pacos	Sommait of *Breithaupt*
Kir	Palladium Ochre	Sphenomatite
Klappentein	Peucalite of *Thomson*	Steatoid
Konilite	Phyllin Glance	Steel Cobalt
Koodilite and Korcite of *Dufrenoy*	Pierre de Marmarosch of *Klaproth*	Stephensonite
Leedsite of *Thomson*	Polyhalite de Vie	Stibilite
Leuzinite of *Salvetat*	Prasochrom of *Landerer*	Stibite
Leptonemerz of *Breithaupt*	Protherite	Timagite
Luscite	Pyromeline of *Kobell*	Trichite of *Zirkel*
Mancinite	Pyrophane	Uigite of *Heddle*
Margode	Regikite	Verrucite of *Apjohn*
Mariatite	Richmondite of *Kenngott*	Vignite of *Watts*
Melardheim	Röesmerite	Warthite
Melaxoite	Schlaken	Xerasite
Melinite of *Glocker*	Schreiberite	Xylocryptite
Melosark		Zamtite
		Zavalite
		Zoïdon

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 6, August 10, 1874.

New Memoir by M. Helmholtz.—M. Bertrand.—A controversial paper in reference to a former essay by the author entitled, " Examination of the Law Proposed by M. Helmholtz to Represent the Action of Two Elements of the Current," and to a recent memoir published by M. Helmholtz in the *Journal fur Reine und Angewandte Mathematik*, of Berlin (Band lxxviii., Heft. 4).

Fifth Note on the Conductivity of Woody Bodies.—Th. du Moncel.—In this lengthy paper the author examines the influence of the direction of the fibres of wood upon its power of conducting electricity.

Researches on Explosive Bodies.—M. Noble and F. A. Abel.

Destruction of the Phylloxera.—M. La Perre de Roo.—The author finds that the water in which flax has been steeped destroys all insects, the phylloxera included, without being injurious to vines.

Application of Gilded Glass in the Construction of the Camera Lucida.—M. G. Govi.—It is known that the construction of the *camera lucida* is founded upon the simultaneous perception of two images—that of the object and that of the pencil. Various means have been employed to arrive at this result. In that of Soemmering it is a metallic mirror smaller than the pupil; that of Amici is constructed on the principle of reflection on a plate with parallel faces; that of Wollaston, at present most in use, consists in a prism, of which the edge, dividing the pupil in two parts, permits the object to be seen by the upper half, and simultaneously the pencil by the lower portion. In all these systems the fusion of the images is somewhat difficult to seize, especially for certain points

of the reflected image. Govi, professor of physics at the Royal University at Rome, proposes to cover with a thin layer of gold the reflecting surface of a prism, and to apply upon this, with Canada balsam, a second prism with like angles. Although this layer of gold is sufficiently transparent to allow the luminous rays to pass, its power of reflection is considerable, and it gives images of great brightness. We have thus a perfect means of superimposing, without fatigue to the eye, two different images—the one direct, and the other reflected. The principle is the application of that property of thin plates—metallic or otherwise—to transmit simultaneously direct rays, and to reflect rays which arrive obliquely from another source.

Stratification of Electric Light.—M. Bidaud.—The author, repeating the experiment with electric light in rarefied air, replaced the tube used for demonstrating the law of the fall of bodies in a vacuum, commonly employed in this case, with a straight Geissler tube with three bulbs, of 0·6 metre in length. One of the platinum wires was connected with the ground by means of a small chain, and that from the other end was brought near the conductor of a Carré's machine. A light was thus obtained as stratified as if the tube had been connected with the wire of a Ruhmkorff's coil. The phenomenon only showed itself when the wire was 1 to 4 centimetres removed from the conductor.

Decolourising Charcoals, and their Artificial Production.—M. Melsens.—The only process which allows of producing artificial decolourising charcoals, approaching in their properties to bone-black, consists in impregnating woody matters with phosphate of lime dissolved in hydrochloric acid. The phosphates are thus distributed as they are in natural bones. The mass thus prepared is ignited. The difficulty consists in obtaining products of a sufficient density and mineral richness, and free from foreign salts. The charcoal obtained has to be washed in excess of water to remove chloride of calcium if poor coprolites have been employed. The author uses the coprolites found in small granules in the grey phosphatic chalk of Ciply.

Constitution of Clays.—M. Th. Schlœsing.—(Second note.) The various silicates of alumina, the mixtures of which constitute clays, have not yet been isolated, as their chemical and physical behaviour offers no differences sufficiently well marked. Levigation does not even enable us to separate clay from fine sand, much less to distinguish the several silicates. Water rendered slightly alkaline enables us to separate the clays which remain suspended, and which may be compared to colloid bodies, from those formed of grosser particles which collect at the bottom of the vessel. It is thus possible to fractionate the deposits, and to analyse the successive lots. The suspension of clay in alkaline water offers another means of analysis hitherto unforeseen. After some days of repose, the clayey liquid separates distinctly into superposed horizontal strata, increasing in opacity from the top to the bottom of the vessel. The formation of these strata can be explained only by the presence of several silicates, classified by gravitation according to an order which depends on the shape, the size, and the density of their particles. In case of a clay which, like certain kaolins, contains only one silicate, only one stratum is seen. Many analyses of kaolins have been published, especially by Brongniart, Malaguti, Ebelmen, and Salvetat. These chemists not being able to remove foreign matters, such as felspar, mica, and quartz sand, by levigation, have had recourse to certain solvents, acid and alkaline, capable of attacking merely the kaolinic clay. The elements of this substance were then sought for in the residues and in the solvents. Such procedures give the gross composition of the clay, but they fail to show whether the sample consists of several silicates or of one only. Agitation discovers in alkaline liquids, holding certain clays in solution, a mirror reflection, varying much in the different kaolins, and due to crystalline particles. On examining certain

clays under the microscope we sometimes find minute crystals with well-defined angles.

Determination of Tannin.—MM. A. Muntz and Ramspacher.—A modification or the " raw hide " method. A morsel of hide, softened in water, is stretched over a small drum of zinc, 0·06 metre in diameter, and secured by means of a copper wire. The opposite face of the drum terminates in a tube, to which can be adapted an india-rubber tube, 1·5 to 2 metres in length, and terminating in a funnel. Into this a known quantity of the extract of the sample is poured, so as to fill it. The first 4 or 5 c.c. which run through the skin are rejected. 25 c.c. of the filtrate are evaporated to dryness at 100° C., and the same quantity of the original liquid. The difference is tannin.

An Arrangement for Collecting the Iodine Volatilised during the Manufacture of Superphosphate.— M. P. Thibault.—The presence of iodine in certain mineral phosphates from the deparments of Tarn-et-Garonne, and of Lot, is well known. The author has also found it in the phosphorites of Nassau, and of Cocues, in Estremadura. His arrangement for collecting the iodine consists mainly of a cast metal dolly, which receives continuously the powdered mineral and the acid in constant proportions. The mixture falls into brick chambers, where it becomes solidified. A powerful aspirator draws the acid vapours evolved, and forces them to traverse a sheet-iron column filled with coke moistened with water. The same volume of liquid is passed repeatedly over the coke. It may be brought to contain 8 grms. of iodine per litre in the state of proto-iodide of iron, the metal which forms the apparatus being attacked. In the liquid are also found chloride and fluoride of iron, but not a trace of bromides. The liquid may be treated according to the method of Serullas with a suitable quantity of sulphate of copper. The amount of iodine present in the liquid must be determined by a preliminary assay. A grey powder is thrown down, Cu_2I,HO. This is washed in water, drained, and dried. To extract the iodine it is heated with an excess of oil of vitriol, when the iodine is deposited in the cool parts of the apparatus. The greater portion of the iodine, however, is not volatilised, but remains entangled in the mass.

Etherification of Glycol.—M. Lorin.—The reciprocal action of oxalic acid and of glycol is analogous to that of glycerin. It differs from it, however, in the point that the formines are partly eliminated, and that diformine is found on distilling the formic acid produced. The formines are obtained also by substituting formiate of potash for acetate in the preparation of glycol. The preparation of glycol, and of its ethers, may be generalised by the employment of any salt, and of any alcohol along with bi-bromide of ethylene, and the simultaneous production of the ethers of the mono-atomic alcohols.

Tetra-Terebenthen — a Solid Polymer of the Essence of Turpentine.—M. J. Ribau.—Not adapted for abstraction.

Albumens of White of Egg, with Reference to the " Reclamation " of Arm. Gautier.—M. A. Béchamp.— A controversial paper. (See *Comptes Rendus*, lxxvii., p. 1588.)

Analysis of Specimens of Beef as Sold in the Markets of Paris.—Ch. Mène.—A tabular view both of the ultimate and proximate constituents of the flesh from different portions of the animal.

Liebig's Annalen der Chemie und Pharmacie.
July 3, 1874.

On Meta-Toluydin.—F. Lorenz.—This base was prepared according to the method of Beilstein and Kuhlberg. It is a colourless oil, which on exposure to air grows darker and becomes resinous. Its boiling-point is 197°, and its sp. gr. at 25°=0·998. The following are its characteristic reactions as compared with ortho-toluydin and para-toluydin :—

1. The base, dissolved in bihydrated sulphuric acid, is mixed with chromic acid, previously dissolved in sulphuric acid of the same degree of concentration.

Ortho-Toluydin (Pseudo-Toluydin).—Blue colouration, which on dilution with water passes into a permanent violet-red.

Meta-Toluydin.— Yellowish brown colouration, becoming a clear brown if heated ; on the addition of a little water it becomes a greenish yellow ; more water renders it colourless.

Para-Toluydin.—Yellowish colour.

2. A little nitric acid is added to the solution of the base in bihydrated sulphuric acid.

Ortho-Toluydin (Pseudo-Toluydin).—Orange colour ; brown if solution is highly concentrated ; becomes yellow again on the addition of water.

Meta-Toluydin. —Immediate reddish colouration, rapidly passing through intense blood-red to a dirty dark red ; then, on the addition of water, orange colouration.

Para-Toluydin.—Blue streaks, which soon extend, turning the whole liquid deep blue. After one minute the colour becomes violet, then red, and, after a few hours, brown.

3. The base is dissolved in equal measures of ether and water, and a few drops of a clear solution of chloride of lime are added.

Ortho-Toluydin (Pseudo-Toluydin).—The aqueous layer turns first yellow and then brown ; the ether, decanted and shaken up with a little dilute sulphuric acid, takes a very permanent violet-red colour.

Meta-Toluydin.—The aqueous layer turns a turbid yellowish brown ; the ethereal takes a reddish reflection, and if decanted and shaken with an equal volume of water and a drop of dilute sulphuric acid, it shows a faint violet colouration in its lower stratum.

Para-Toluydin.—No reaction.

The paper further contains a description of the acid oxalate of meta-toluydin, $C_7H_9N,C_2H_2O_4$; the sesqui-oxalate, $(C_7H_9N)_3(C_2H_2O_4)_2$; the neutral oxalate ; the sulphate, nitrate, and hydrochlorate ; metamidortho-sulpho-toluolic acid and its salts : tribrom-meta-toluydin ; and meta-toluydin-sulphuric acid and its salts.

Quantitative Determination of Para-Toluydin in Presence of Ortho-Toluydin.—F. Lorenz.—In the *Ann. de Chim. et de Phys.* (1872), xxvi., 249, Rosenstiehl describes a method for this determination, depending on the insolubility, or sparing solubility, of the oxalate of paratoluydin in pure ether. 0·2 grm. of the mixed bases are dissolved in 80 grms. of ether, and a solution of oxalic acid in ether (1·062 grms. acid in 250 c.c. ether) is added from a burette as long as a precipitate is formed. He maintains that the end of the reaction can be easily recognised. Lorenz finds it better to place in the liquid a piece of blue litmus paper, which reddens as soon as all the para-toluydin has been precipitated in the state of oxalate. The determination is still more accurate if to the ethereal solution of the bases oxalic acid be added in known excess. The precipitate is filtered off, and washed with a little ether ; the filtrate is evaporated to dryness, the residue dissolved in a little water, and titrated with decinormal soda, with tincture of litmus as indicator. The difference between the amount of oxalic acid thus found and the quantity originally added, gives the quantity which has combined with para-toluydin.

Meta-Brom-Ortho-Sulpho-Toluolic Acid.—Dr. E. Weckwarth.—Not adapted for abstraction.

Ortho-Amido-Para-Sulpho-Toluolic Acid.—Dr. M. Hayduck.—The author describes this acid, its baryta and lead salts ; the ortho-brom-para-sulpho-toluolic acid, with its potash, baryta, and lead salts ; its chloride and amide ; the products yielded on distillation with hydrate of potash, viz., aniline, anthranilic acid ; the chloro-toluchinons obtained on treating the amido acid with hydrochloric

acid and chlorate of potash; dibrom-ortho-amido-para-sulpho-toluolic acid, obtained by treating the ortho-amido-para-sulpho-toluolic acid with bromine; diazo-ortho-amido-para-sulpho-toluolic acid; ortho-cresol-para-sulphuric acid with its salts; the nitro-diazo compound; nitro-ortho-cresol-para-sulphuric acid; and nitro-ortho-brom-para-sulpho-toluolic acid.

New Nitro-Toluydin.—O. Cumerth.—This compound forms long, pale yellow, crystalline needles, grouped concentrically, sparingly soluble in water, but readily in alcohol. It dissolves in concentrated acids, forming very unstable compounds. Its formula is $C_7H_6(NO_2)NH_2$.

Para-Amido-Ortho-Sulpho-Toluylic Acid.—Dr. F. Jensen.—This acid has the composition—

$$C_7H_6(NH_2)SO_3H,H_2O.$$
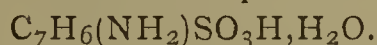
It forms hard, colourless, well-developed rhombohedral crystals, but never pale yellow long columns. It does not lose its crystalline water over sulphuric acid, and decomposes at elevated temperatures without fusion. It is sparingly soluble even in warm water, and insoluble in alcohol and ether.

Certain Decompositions of Pyruvic Acid.—Dr. C. Böttinger.—A very long paper, not adapted for abstraction.

Acenaphthen and Naphthalic Acid.—Arno Behr and W. A. van Dorp.—A characteristic of acenaphten is its picric acid compound, which is very permanent, forming orange prisms, and is sparingly soluble in alcohol. The authors describe naphthalic acid and certain of its salts, naphthalimid, naphthal-methylic ether, and acetylen-naphthalin.

Volume Constitution of Solid Bodies.—Dr. H. Schrœder.—The author examines the isosterism of the corresponding seleniates and chromates.

Examination of Coal-Tar Oils more Volatile than Benzol.—K. Helbing.—We shall endeavour to insert this paper *in extenso*.

Examination of a New Fossil Resin.—K. Helbing.—This resin is found sparingly in a stone quarry at Enzenau, between Tölz and Heilbrunn. It has a dark brown colour, a resinous lustre, and a conchoidal fracture. It is faintly translucent on the edges, very friable, and gives a yellowish grey powder. At 300° it is still solid. If heated upon platinum-foil it melts and burns, giving off a pleasant aromatic odour, and leaving a bulky carbonaceous residue. It was found interspersed with iron pyrites in so fine a state of division as only to become visible on elutriation. It was composed of—

Carbon	74·15
Hydrogen	9·53
Oxygen	1·91
Bisulphide of iron	14·41
	100·00

The ash being deducted, its percentage composition is—

Carbon	86·68
Hydrogen	11·14
Oxygen	2·18
	100·00

On treating 10 grms. of the finely-pulverised resin with ether a portion was dissolved. The ethereal solution had a yellowish brown colour, with a green fluorescence; and after evaporation left 2·8 grms. of a brown resinous mass, which became brittle when dried at 100°, and yielded a pale yellow powder. By repeatedly treating with hot alcohol the part soluble in ether a portion was extracted. The portion soluble in ether, but not in alcohol amounts to 19 per cent; the part soluble in both, to 9 per cent; and the residue, insoluble in both, 72 per cent. Bisulphide of carbon, benzol, and chloroform dissolved the two former portions, but had no action on the insoluble residue. The latter portion gave on analysis—

Carbon	73·12
Hydrogen	9·30
Bisulphide of iron	17·10
	99·52

Or deducting the pyrites—

Carbon	88·21
Hydrogen	11·22
	99·43

On Cymols.—F. Fittica.—The author contends that the cymols from camphor, oil of ptychotis, and thymol are identical, and that the propyl which they contain is the normal form.

Constitution of Benzol.—A. Ladenburg.—A hypothetical paper.

Derivatives of Phloretin.—Hugo Schiff.—The compounds spoken of are phloretinic acid, phloroglucin, phloroglucid, and triphloretid. The author has endeavoured to convert certain fatty and aromatic oxycarbon acids into tannic acids by the action of the oxychloride of phosphorus.

Reimann's Farber Zeitung, No. 28, 1874.

This number contains a continuation of the directions for dyeing plushes; receipt for a black on woollen felt; continuation of article on management of vats; production of a fine violet ground on vatted cottons; orange reserve for indigo-blue styles; steam colours for thibets, shawls, &c.; and crimson for woollen and mixed garments.

No. 29, 1874.

This number contains a notice of an aniline ponceau made by Schlumberger, of Brussels, the manufacture of which is not explained. The patent colours of Croissant and Bretonnière are now manufactured on the large scale, and are found useful for browns, greys, and drabs. The water used must be free from lime. Cotton goods after dyeing are raised in a weak boiling bath of bichromate of potash, passed through a dilute boiling solution of soda, washed, and dried. There are receipts for blue-black, green, and bright madder red on wool; conclusion of the treatise on plushes; a receipt for a light blue on cotton yarn; an orange reserve for indigo styles; receipts for a brown, two shades of green, and marine blue on felt hats, and for printing with indigo by the hydrosulphite process.

No. 30, 1874.

Aniline Black for Printing Yarns.—The following colour is recommended for block work:—

Gum tragacanth water	..	1 litre.
Water		1½ ,,
Sublimed aniline black	..	280 grms.
Chlorate of potash ..	..	80 ,,
Water		1½ litres.

The "sublimed aniline black" is only prepared by Schlumberger, of Brussels. After printing, dry and age for forty-eight hours at 30° with a damp atmosphere. As soon as the colour appears of a greenish black wash, and pass through a weak chromate bath, and then through soda. Wash and dry. This number contains a continuation of the paper on fixing indigo by the "hydrosulphite" process; receipts for dark and light greens on linen and cotton; for a pansy, lavender, and prussian blue on cloth.

Gold Lacquer for Leather.—Make a concentrated solution of magenta in an alcoholic solution of shellac.

Dingler's Green.—A mixture of phosphate of chrome and phosphate of lime.

Cœrulignon.—Fischer, on thickening this supposed blue colour with gum, printing, washing, and passing a chrome bath, obtained not a blue but an orange.

No. 31, 1874.

This number contains directions for dyeing Nicholson blue *in rhyme*; a receipt for printing black upon woollen

goods for rainbow effects ; formulæ for different shades of mode on shoddy ; a straw colour on woollen yarn ; and a Bismarck brown on felt hats. There is, further, a continuation of the instructions for working the new " hydrosulphite " vat.

Coupier's colour works at Poissy, near Paris, the establishment where the nitro-benzol colours originated, are said to be finally closed.

As a test for dextrin fraudulently introduced into gum-arabic, it is recommended to pour a concentrated solution of ferric chloride upon the mixture. The gum-arabic adheres to the bottom of the vessel, whilst the dextrin remains loose.

The ancient Egyptians are said to have used as ink, soot suspended in a boracic solution of shellac.

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Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, No. 16, 1874.

Numerical Relations Between the Volume of Compound Bodies and the Atomicity of their Elements. —M. Mehay.—If the formula of a carbonated compound body is written under a double volume of that of the quantity of hydrogen taken as an equivalent, it will be observed that the sum of the atomicity of all the elements comprised in this formula is an even number, and that the number of the atomicities of each of the elements which it contains is a multiple of the atomicities of these elements.

Specific Heat of Bodies, and Density of the Ether. —M. Ch. Puschl.—The author points out a connection between the anomalous specific heat of carbon and the anomalies offered by its transparency, with regard to the thermic radiation of bodies at a low temperature. He holds that the *vis viva* of atomic movements in solid bodies is small in proportion to the quantity of rays accumulated by reflection in the ether occupying the interstices between the atoms ; bodies are almost absolutely opaque for their internal radiation whilst the temperature does not exceed ordinary limits ; the weights of the chemical equivalents of bodies are not relative atomic weights, but rather quantities of weight having an equal atomic surface.

Paper from Mulberry Bark.—The bark of the mulberry tree can, it is said, be easily and cheaply converted into an excellent material for paper.

New Method of Making Pulp for Paper.—V. E. Keejan forces a cold alkaline lye into the pores of the woody fibre of plants by hydraulic pressure. After this a simple washing suffices to obtain the mass in a suitable condition.

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Anderson's University.—Professor Dittmar, F.R.S.E., Owen's College, Manchester, has been appointed to the Chair of Scientific Chemistry at Anderson's University. Mr. Dittmar succeeds Dr. Thorpe, F.R.S.E., who is now Professor of Chemistry at the Yorkshire College of Science, Leeds.

NOTES AND QUERIES.

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Preparing Crystals of Phosphorus.—W. Douglas Herman (*Chem. Centr.*, 1874, 3) and J. Lawrence Smith (*Dingl. Polyt. Journ.*, ccxi., 402), *Journ. Chem. Soc.* II. series, vol. xii., page 869, give methods] for preparing crystals of phosphorus, by exhausting a tube, sealed up at one end, containing a piece of phosphorus, sealing up the other end when exhausted, and a'lowing it to stand for a few weeks. Two years ago I proposed to try the action of phosphorus on nitrogen gas. I filled a tube, sealed up at one end, with nitrogen gas, placed a piece of phosphorus in it, and sealed up the other end. I then heated it before the fire, melted the phosphorus, and spread it over the sides of the tube, and placed it on one side, thinking of heating it in a water-bath. On looking at it a few days after, I was surprised to find small crystals beginning to form, so I abandoned the idea of heating it any further, but allowed the crystals to form. In about a month beautiful colourless crystals had formed on the sides of the tube. The crystals remained colourless four or five months, and then gradually turned lemon-yellow. At the present time a great number have disappeared, the tube having a small hole in it, caused by the expansion of the gas when sealing up the tube.—GEORGE WHEWELL, F.C.S.

THE CHEMICAL NEWS.

VOL. XXX. No. 776.

ON ARSENIC FLUORIDE.

By R. W. EMERSON MACIVOR.

ARSENIC trifluoride, $''As'''F_3$, is obtained by the action of sulphuric acid (H_2SO_4) on an intimate mixture of dry calcium fluoride with anhydrous arsenic trioxide, contained in a small leaden retort. At a low temperature it distils over, and may be collected in a dry glass receiver. The reaction which takes place is represented by the following equation :—

$$3H_2SO_4 + ''As'''_2O_3 + 3Ca''F_2 =$$
$$=3Ca''SO_4+3H_2O+2''As'''F_3.$$
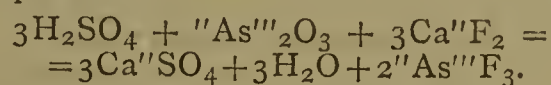
Arsenic trifluoride is a colourless, very volatile liquid, emitting dense vapours on exposure to the air, and boiling under the ordinary atmospheric pressure at 64° to 66° C. Its specific gravity is = 2·66. It is miscible with alcohol and ether. Water immediately decomposes it, with production of arsenic trioxide and hydrofluoric acid. When perfectly anhydrous, it does not exert any action on glass, but in the presence of a small quantity of water it corrodes that substance. When submitted to the action of a stream of dry ammonia, it absorbs a quantity of the gas, yielding a white, non-crystalline mass, which dissolves in alcohol and ether, but is decomposed by water, with formation of ammonium fluoride and arsenite.

Glasgow.

ON THE ESTIMATION OF FERROUS OXIDE IN SILICATES.

By WILLIAM EARLY,
Demonstrator of Chemistry in Trinity College, Dublin.

THE accurate estimation of ferrous oxides in silicates which are insoluble in acids is a task of well-known difficulty, and the methods usually employed are open to obvious objections. The process generally recommended consists in fluxing the powdered silicate with a mixture of potassium and sodium carbonate, or with potassium acid sulphate, and subsequently dissolving the fluxed mass in hydrochloric or sulphuric acids, and titrating with potassium permanganate or bichromate. Now this method is evidently subject to the following sources of error :— (1) During the fluxing, the ferrous oxide will inevitably absorb oxygen from the air ; (2) if manganous oxide is present, it is always partially converted into potassium manganate, which, on addition of acid, will oxidise the ferrous salt. The following process, which I have practised with success, is free from the above-mentioned sources of error, and may be recommended for the ease and rapidity of its accomplishment :—

About 2 grms. of the finely-powdered mineral are placed in a deep platinum crucible, and 40 c.c. of hydrofluoric acid (containing about 20 per cent HF) are added. The whole is heated to near the boiling-point, and occasionally stirred with a platinum wire until the disintegration of the silicate is complete, which usually takes place in about ten minutes. 10 c.c. of sulphuric acid diluted with an equal volume of water are now added, and the heat is continued for a few minutes. The crucible and its contents are then quickly cooled, diluted with water which has been freed from oxygen by previous boiling, and the ferrous salt present is estimated by titration with potassium permanganate or bichromate.

It may be remarked that hydrofluoric acid which has been prepared in a leaden vessel invariably contains sul-phurous acid. In order to render such acid fit for use, potassium permanganate must be added until the colour exactly ceases to be discharged.

I have lately had occasion to analyse a large number of trap-rocks, and have found that in every case I obtained a far larger percentage of ferrous oxide by dissolving the mineral in hydrofluoric acid, than by fluxing it with sodium and potassium carbonate.

Thus, in the analysis of a trap-rock which contained 1·2 per cent of manganous oxide, I obtained 5·73 per cent of ferrous oxide by solution in hydrofluoric acid, whereas the method of fluxing only yielded 1·3 per cent.

NEW APPARATUS FOR THE CONDENSATION OF AMMONIA AND CHLORINE.

By SERGIUS KERN, St. Petersburg.

FOR the purpose of condensing ammonia and chlorine, Faraday used a strong, bent, sealed tube. It being necessary to break this tube after every experiment, in order to obtain the condensed gas, I employ an apparatus of the following description, which has this merit, that it will serve for an indefinite number of experiments :—

The apparatus consists of a strong bent tube, as shown ; one end being sealed, and the other formed into a sphere
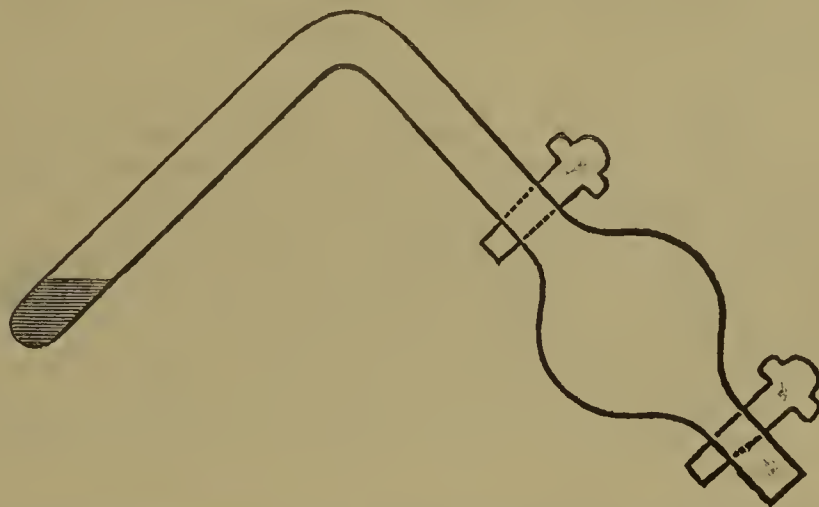
having two cocks, one on each side of the sphere. In order to obtain either of these condensed gases, chloride of silver saturated with ammonia, or hydrate of chlorine ($Cl_{10}H_2O$), is introduced into the sealed end of the tube through the cocks. The cocks being then closed, the operation is conducted in the usual manner.

AMOUNT OF CARBONIC ACID IN THE AIR OF CANAL BOATS.

By CHARLES A. CAMERON, M.D.,
Professor of Hygiene, Royal College of Surgeons ; Chemical and Sanitary Officer, Corporation of Dublin, &c.

(1). CABIN, 183¾ cubic feet ; three occupants, each having 61¼ cubic feet. No windows or ventilators, except, for the latter, a hatch, 4 square feet ; height of cabin, 3 ft. 9 in. ; close iron stove, burning peat. Amount of carbonic acid (8 a.m.), 0·34 per cent.

(2). Cabin, 4ft. 3 in. high, 400 cubic feet ; a close iron stove burning peat ; three occupants, but two absent the night before examination. Amount of carbonic acid, 0·098.

(3). Cabin, 3½ feet high, 350 cubic feet ; stove burning peat. No opening, save hatch of 4 square feet ; occupants, two men and a boy. Air, at 7.30 a.m., felt very close. Amount of CO_2, 0·365 per cent.

(4). Cabin, 4 ft. 10 in. in height ; 360 cubic feet. No ventilators, save hatch of 3 square feet ; iron stove, burning peat ; three men sleep in one bed, a boy in another, and two dogs on the floor. Air (8 a.m.) felt oppressive. Amount of carbonic acid, 0·95.

The persons sleeping on board canal boats are very liable to phthisis, and other diseases produced or aggravated by breathing vitiated air.

THE NEW DYES OF CROISSANT AND BRETONNIERE.

By ADOLPHE OTT.

THE new dyes of Messrs. Croissant and Bretonnière, of Laval (Dept. Mayenne, France), comprise all shades of brown, yellow, and grey; some tints of lilac, greys, and violets, also a colour very nearly approaching black, have thus far been produced. They are not very brilliant when compared with the aniline dyes, but they are of a peculiar warmth of tone, which makes them especially suited for fashion colours (*Modefaerben*). In combination with the wood and extract colours, as well as with the aniline dyes, very beautiful new shades are obtained. Besides, they surpass in durability any dyes known, being not in the least affected by either strong acids or alkalies. The sources from which the new colouring matters are obtained embrace almost all organic substances, amongst which are more particularly mentioned:—Wood, sawdust of all kinds, humus and vegetable detritus, lichens and mosses, bran, farina, gluten, starch, fecula, sugar, glucose, cellulose, paper and cotton waste, tannin, gallic acid, gelatin, casein, fibrin, blood, horn, soot; tartaric, citric, and formic acids and their alkaline salts; resin; aloes, guaiacum, dragon's blood; gum resins, such as gumlac, &c.

The process by which those dyes are produced consists in the treatment of the organic body to be operated upon with certain sulphides at a more or less elevated temperature, according to the nature of the substances under treatment and the tint required. The process of manufacture is exceedingly simple; it requires neither costly nor complicated apparatus, and little labour. According to a calculation of Messrs. Wirth and Co., in Frankfort-on-the-Maine, who are the sole agents for the inventors, the cost of a factory for the production of 100,000 lbs. per year will not exceed £2010, while the net profit appears to be much greater than that reaped in the manufacture of the aniline colours.

The new dyes are generally of a much greater intensity than most natural dyes: they are soluble in water, and, what is very important, especially in calico-printing, they adhere to the fibre without any mordant—still they are mostly fixed by means of bichromate of potash; and finally they are cheaper than any dyes known.

The Société Industrielle de Mulhouse (Alsace) has expressed itself very favourably on these products, and will shortly publish an extensive report. Favourable testimonials were also given by dyers from Lille, Roubaix, Tourcoing, Rouen, Chôlet, and Laval, and for a year and a half the inventors have carried out their process in their own factory, where it can be witnessed. The dyes are known in France as "*Grands Teints.*" I understand that a factory of these new products is already in operation in Göttingen, and that others are to be erected in Breslau and in this city.

Frankfort-on-the-Maine,
Sept. 30, 1874.

CHEMICAL STUDIES OF THE PEPPERS OF COMMERCE.

By A. WYNTER BLYTH, M.R.C.S., L.S.A., A.K.C.; Analyst to the County of Devon; Medical Officer of Health, &c.

IT will be indispensable for some time to come to accumulate facts on the properties of articles of food in the *pure* state. The exact amount of ash, the solubility of substances in different liquids, the specific gravity of the aqueous infusion, &c., many of them, when applied to foods, wholly uninteresting to the ordinary chemist, become of great value in the technical examination of articles suspected of adulteration. However unimportant some slight variation in solubility, for example, may be in a purely chemical sense, yet if that variation be, within certain limits, constant, it is of the greatest utility to the Public Analyst.

The peppers I have examined were obtained from the importers in the berry, and ground by myself; they are, I believe, specimens of pure pepper. The following are the methods adopted in the examination:—

The ash was burnt at a very low temperature in a platinum dish, supporting a chimney to increase the draught; the soluble ash was obtained by boiling the ash with water, filtering, evaporating the soluble ash down in a platinum dish, heating to dull redness, and weighing; the aqueous extract by putting 4 grammes of pepper in a large flask with 500 c.c. of water, distilling over 200 c.c., returning these into the flask, when cool filtering, weighing, and evaporating $\frac{1}{10}$th; the ammonia, by taking 5 c.c. of the last liquid and distilling it with 50 c.c. of alkaline permanganate by Wanklyn's method; and the alcoholic extract, by treating about 1 grm. of the dry pepper with repeated quantities of alcohol, and boiling for some time in a flask connected with a reversed Liebig's condenser. I have not yet estimated the piperine in the peppers; indeed, although it can be extracted with comparative ease, the crystallisation of the alkaloid and the separation of the resin takes up so much time that the process, however satisfactory, cannot be very attractive to analysts, who have to examine a great number of samples in a short time.

Ash.

	Soluble Ash.	Total Ash.	
		Pepper in the Dry State.	Pepper in its Ordinary Condition.
	Per cent.	Per cent.	Per cent.
Penang	2·2120	4·189	3·8480
Tellicherry	3·3800	5·770	5·3460
Sumatra	2·6260	4·316	3·3340
Malabar	3·4530	5·195	4·6740
Trang	2·5380	4·775	4·2110
A white pepper, ground by myself, bought at a retail shop	0·5584	1·120	0·7889
Long pepper	4·4720	8·308	7·1543

The first five peppers give, as the mean of the soluble ash, 2·84 per cent of the dried substance, the two extremes being respectively 3·453 and 2·212. The mean of the total ash of the five peppers is 4·845 per cent, the two extremes being 4·189 and 5·770.

Hygroscopic Moisture.

	Per cent.
Penang	9·531
Tellicherry	12·908
Sumatra	10·103
Malabar	10·548
Trang	11·664
Long pepper	10·778

It is worthy of note that, as the peppers were finely powdered and kept on the water-bath for many hours, besides water, the volatile oil would to a considerable degree be dissipated.

The total loss of weight may be stated generally at 11 per cent.

Alcoholic Extract.

	Grms. per cent of Dry Pepper.
Penang	7·650
Tellicherry	7·836
Sumatra	6·450
Malabar..	6·375
Trang	6·300
The white pepper before-mentioned..	7·650
Long pepper..	2·600

The extract was thoroughly dried before weighing; it may be said to be never less than 6 per cent in black and white peppers. The small extract yielded by long pepper is noteworthy.

Aqueous Extract.

	The Dry Substance yields to Water. Per cent.
Penang	18·335
Tellicherry	16·500
Sumatra	17·500
Malabar	20·375
Trang	18·175
Long pepper	16·825

The total ammonia yielded, in the manner before-mentioned, expressed in percentage :—

100 grms. of—

			NH_3.	Nitrogen.
Penang pepper yield to water			0·450 =	0·370
Tellicherry	,,	,,	0·450 =	0·370
Sumatra	,,	,,	0·375 =	0·310
Malabar	,,	,,	0·295 =	0·243
Trang	,,	,,	0·325 =	0·300
Long	,,	,,	0·175 =	0·144

As 100 parts of piperine contain 4·9 of nitrogen, if the nitrogen be considered as dissolved piperine, the mean of the piperine boiling-water takes up, and when cold retains, of the first five peppers=0·017. The small yield from long pepper is a great distinguishing mark.

Barnstaple, Sept. 23, 1874.

NOTES UPON ANIMAL CHARCOAL. THE PRESENCE OF FERROUS SULPHIDE IN CHAR.

By ROBERT FRAZER SMITH, F.C.S.

ALL chemists usually state the total sulphur in char as calcic sulphate, even when the sample is from an old working stock. When any notice is taken of sulphides they are generally reported as calcium monosulphide. It appears to me that ferrous sulphide is always the sulphur compound present, and not the calcium sulphide. The latter occurs in new char in exceedingly minute quantity. All the calcium sulphides are soluble in acetic acid with evolution of H_2S.

Anhydrous ferrous sulphide is not in the least affected by this acid, but with HCl, however dilute, at once evolves H_2S. The majority of chars when boiled with glacial acetic acid (free from mineral acids) fail to yield the faintest trace of H_2S. If now the residue from the acetic acid be washed and HCl added, H_2S will come off in abundance.

Expt. 1.—A mixture of calcic sulphate and lamp-black, heated in a crucible to a full red heat, on cooling was treated with acetic acid. The whole of the sulphides were decomposed by the acetic acid, and HCl failed to evolve any more H_2S from the residue.

Expt. 2.—Powdered recently prepared iron sulphide was boiled with glacial acetic acid, but no H_2S was liberated. It would therefore appear that the iron, and not the lime compound is what we have to deal with in char.

It is undoubtedly the case that the sulphur is produced in the revivification from calcic sulphate at the expense of the carbon, but the sulphur transfers itself at once to the iron. The following are the amounts of sulphur stated as such in three working stocks from well known and successful sugar refineries in various parts of Britain. The iron is also stated for comparison.

	I.	II.	III.
Sulphur	0·15	0·19	0·27
Iron	0·43	0·24	0·71
Calcic sulphate ..	0·33	0·51	0·17

An attempt was made to find out in which grist of char the most free sulphur (or ferrous sulphide) resided.

A sample gave when divided into these various sizes—

Above 12 meshes per inch	=0·25 sulphur
12 to 16 ,, ,, ,,	0·17 ,,
16 to 24 ,, ,, ,,	0·16 ,,
24 to 30 ,, ,, ,,	0·17 ,,
30 to 40 ,, ,, ,,	0·18 ,,
40 to 50 ,, ,, ,,	0·19 ,,
Under 50 ,, ,, ,,	0·17 ,,

Some continental refiners use caustic soda to remove organic matter from their char previous to burning.

Expt. 3.—1 lb. stock char was boiled with distilled water containing ½ per cent sodium hydrate upon the char taken. After perfect washing and drying the sulphur was estimated.

Total sulphur stated as calcic sulphate—

Char before treatment ..	1·125 per cent.
Char after treatment	0·915 ,,
Sulphate lost	0·210

But the sulphate as such amounted to—

Before treatment	0·26 per cent.
After treatment	0·27 ,,

Consequently the soda attacked the sulphides in preference to the sulphates. A foreign refinery char, in which soda was used, yielded—

Calcic sulphate	1·520
Sulphur	0·012

Ferrous sulphide is quite readily decomposed by alkalies, and all the evil effects known to arise from the presence of an excess of sulphide in char can be much more easily explained by assuming its presence in preference to calcium sulphide. A curious deposit is frequently seen on the inside of the kiln pipes in certain houses, in fact, more or less in all, but when in great abundance is an evidence of excessive heating. The following results express its composition.

	I.	II.
Iron	60·92	57·55
Sulphur	35·77	31·37
Carbon	—	3·10
Sand	0·41	3·30
Tricalcic phosphate and loss	2·90	5·36
	100·00	100·68

Sp. gr. 4·12

The iron and sulphur calculated to per cents are as follows :—

	Theory.	Pipe Deposit. I.	II.
Iron	56	63·64	63	64·73
Sulphur ..	32	36·36	37	35·27
	88	100·00	100	100·00

It is worthy of note that it is extremely rare to find an accidentally formed iron sulphide having so near an approach to the theoretical numbers. There is generally excess either of iron or sulphur. This deposit is not formed at the expense of the iron of the pipes. These remain *apparently* unchanged. The sulphur and iron have both been undoubtedly derived from the char itself. I propose shortly to show the changes which take place in iron heated constantly in contact with phosphates, and discuss the alleged occurrence of phosphides in char. My thanks are due to my assistant, Mr. John Macdonald, for his help with certain of these and also some succeeding analyses.

Greenock, Sept. 28, 1874.

ON THE FORMATION OF GOLD NUGGETS IN DRIFT.*

By W. SKEY,
Analyst to the Geological Survey of New Zealand.

THE manner in which those gold nuggets have been formed which are found in our drift or fluviatile deposits has long been a subject of profound interest. Our Victorian friends in particular have been greatly exercised with this matter, no doubt from having it so frequently and forcibly presented to them by the almost regular announcement from time to time of the discovery of nuggets so large as to be entitled to description in the annals of their gold fields, and to names to identify them by.

From the circumstance of their attention being thus given to this subject, many valuable observations have been recorded by them, and published in the periodicals or other works emanating from their colony.

The first theory broached to account for the presence of these nuggets in drifts was that they had been broken off some rich reef, and transported by water bodily to the positions in which they are now found by us. At first sight this appears very plausible, but there are several considerations which, when allowed to have their due weight, rather tend to shake our belief in its competency to explain the case. These considerations have been discussed pretty freely in the works alluded to, so I need not detail them here, but will only state that, briefly put, the chief of them are as follows:—The large size of many of these nuggets, as compared with any of the masses of gold yet found in our reefs; their position in the drifts, lying sometimes as they do in the upper layers; and their superior fineness of quality as compared with that of any of the reef gold found in their vicinity.

Impressed by these facts, Mr. A. C. Selwyn proposed another theory for explaining the origin of these nuggets, and one which certainly appears to meet the question upon the particular points just cited. This theory is, "that nuggets may be formed and that particles of gold may increase in size through the deposition of gold from the meteoric waters percolating the drifts, which water, during the time of our extensive basaltic eruptions, must have been of a thermal, and probably of a highly saline character, favourable to their carrying gold in solution."†

At the time this idea was broached, nothing systematic or thorough had been undertaken towards investigating this matter, as to the probable presence of gold in those meteoric or saline waters referred to, and nothing whatever had been accomplished towards showing any likely means by which gold, depositing from such solutions, would be determined upon itself as a continuous coating, and in such quantity as occasionally to form nuggets of the enormous size we find them in such drifts, nor did Mr. Selwyn indeed make any suggestion on this matter; perhaps, considering the initiation of such an idea sufficient for his part, he left the support of it to the ingenuity of chemists, to whom, in fact, such a labour rightfully belonged; in reality, so little was known in support of this theory at the time of its evolution that it seemed in the highest degree chimerical. Since then, however, chemical investigations have given us results greatly in favour of this idea. Thus, in the first place, as regards the presence of gold in a soluble state in the waters percolating our drifts, it appears that Mr. Daintree found gold in pyrites which had obviously replaced the organic structure of a tree occurring in a drift-bed, and Mr. Newbery, Analyst to the Geological Survey of Victoria, afterwards obtained the same results upon other pyrites occuring in a similar manner, both results showing that gold must have been "presented to the pyrites in a soluble form."

Since that time gold has been by no means unfrequently discovered to be present in certain mineral and mine waters, and indeed Mr. Daintree has recently found gold while testing the water of a mine in Victoria.

Perhaps, though, the most important communication we have relative to this subject is that of E. Sonstadt, "On the Presence of Gold in Sea-Water" (CHEMICAL NEWS, vol. xxvi., p. 159). This metal has, indeed, before this been alleged to exist in sea-water, but these allegations have not been sustained with such evidence, and accompanied with such detailed description of processes employed, as entitled them to an unreserved belief on our part. Sonstadt's experiments, on the other hand, are detailed minutely, and his statements are supported by the results of different processes.

The amount of gold present in the water taken from Ramsey Bay he states to be very minute, "less than one grain in the ton;" still the fact of its presence at all in such water is exceedingly interesting, as showing an escape of gold from the land seaward, and so confirms the correctness of the various allegations I have referred to respecting the auriferous character of certain of our springs and mine-waters.

Thus, in different ways, the first question involved in this theory of Mr. Selwyn is answered in a most satisfactory manner.

As to the means by which the gold present in these waters has been reduced therefrom, and aggregated in masses, solid, homogeneous, and occasionally of considerable size, we have no lack of substances certain to be present in these drifts, and capable of effecting the reduction of gold and silver from the kind of solutions likely to be present there. In various kinds of organic matter, and in sulphate of iron, we have substances which will effect this with facility, but we have no sure evidence as yet to show that either of these substances will aggregate the gold, while they reduce, or locate it, in a marked manner, or preferentially, upon the gold already reduced.

That gold will be reduced by these substances is certain, but all our present experience in regard to the deposition of gold by them shows that gold so reduced will be dispersed rather than aggregated, so that it would appear that nuggets of gold could not well be formed in this manner.

In our mineral sulphurets, however, we have agents which are not only capable of reducing gold and silver from solution, but, besides, are capable of locating them when so reduced in coherent and bulky masses.

I may state that their nuclear action upon gold depositing from solution by aid of organic matter was suggested by Mr. Charles Wilkinson,* while their competency to reduce the gold from solution without addition of organic matter was shown by me in vol. iii. of our *Transactions*, pp. 227-230; thus the aggregation of the nuggetty forms of gold from solution becomes a still more simple matter, only one reagent being necessary, so that there is a greater probability of such depositions obtaining than were a double process necessary.

Knowing the action of sulphides, the manner of the mode of formation of a portion at least of these nuggets seems apparent. Conceive a stream or river fed by springs rising in a country intersected by auriferous reefs, and consequently in this case carrying gold in solution; the drift of such a country must be to a greater or lesser extent pyritous, so that the *debris* forming the beds of these streams or rivers will certainly contain nodules of such matters disseminated, or even topping them in actual contact with the flow of water.

It follows, then, from what has been previously affirmed, that there will be a reduction of gold by these nodules, and that the metal thus reduced will be firmly attached to them, at first in minute spangles isolated from each other, but afterwards accumulating and connecting in a gradual manner at that point of the pyritous mass most subject to the current, until a continuous film of some size appears; this being formed, the pyrites and gold is to a certain extent polarised, the film or irregular, but connected, mass

* Read before the Wellington Philosophical Society.
† *Trans. and Proc. Roy. Soc. of Victoria*, vol. ix., p. 53.

* *Trans. Roy. Soc. Vict.*, vol. viii., Art. II.

of gold forming the negative, and the pyrites the positive, end of a voltaic pair ; and so, according as the polarisation is advanced to completion, the further deposition of gold is changed in its manner from an indiscriminate to an orderly and selective deposition concentrated upon the negative or gold plate.

The deposition of gold being thus controlled, its loss by dispersion or from the crumbling away of the sustaining pyrites is nearly or quite prevented—a conservative effect, which we could scarcely expect to obtain if organic matter were the reducing agent.

Meanwhile there is a gradual wasting away of the pyrites, or positive pole, its sulphur being oxidised to sulphuric acid, and its iron to sesquioxide of iron or hæmatite, a substance very generally associated with gold nuggets. According to the original size of the pyritous mass, the protection it receives from the action of oxidising substances other than gold, the strength of the gold solution, length of exposure to it, and rate of supply (velocity of stream), will be the size of the gold nugget.

As to the size of a pyritous mass necessary to produce in this manner a large nugget, it is by no means considerable. A mass of common pyrites (bisulphide of iron) weighing only about 12 lbs. being competent for the construction of the famous " Welcome nugget," an Australian find, having weight equal to 152 lbs. avoirdupois.

Such masses of pyrites are by no means uncommon in our drifts or the beds of our mountain streams. The general velocity of the current flowing over such pyritous matters would in all probability be such as would prevent the development of any crystalline form in the gold thus deposited, as we know very well that for such development motion is unfavourable. The form most likely to be assumed by these deposits then would be the mamillary, precisely that in which our nuggets as a rule occur.

Upon this mode of accounting for the presence of large nuggets in our drifts, their occasional great superiority in point of size to any auriferous mass as yet found in our reefs, and their superior fineness to such reef gold, admits of easy explanation.

First, as regards their comparative size, if we only admit that reef gold is also deposited by pyrites, as I attempted to show in the paper just alluded to, and if we assume that the strength of the gold solutions forming these varieties of gold respectively was not greatly different, it is only reasonable to suppose that the gold masses formed in this manner in drift would attain the greatest dimensions, for in the first place this gold in depositing would certainly aggregate more as the pyrites in the drifts or the river beds would be less continuous and more sparsely distributed than that in reefs.

Further, the supply of gold to pyrites lying in these drifts or river beds (and so exposed to rapidly changing waters) would be far more copious than to pyrites cooped up in a rocky fissure, and so in contact only with water stagnant or nearly so.

And, secondly, as regards the generally superior quality of these nuggets to gold found in the reef, it will, I think, appear from the following considerations that such a difference in favour of drift gold is to be expected.

I have previously shown* that silver is deposited with greatest rapidity and certainty upon pyrites from solutions which are alkaline from presence of the fixed alkalies or alkaline earths, and that, as such solutions are passed from this condition to an acid one, the silver present in them is retained in solution ; any gold, however, that may be mixed with such silver is deposited upon this reducing agent, no matter which of these conditions the solvent is in.

Now this alkaline condition is precisely that in which, as far as we can ascertain, our lodes or rocks must have been at the time of the deposition of the gold and silver now found in them, and this alkalinity would especially

manifest itself in those reefs which traverse rocks of a basic nature, such as diorites or serpentines ; hence, by the way, the large proportion of silver alloying the gold found in these reefs, as compared with that alloying the gold found in the lodes of our schists or older formations.

But, though the waters percolating our reefs must be to a more or less extent of an alkaline nature, the drainage waters issuing from them will lose a portion of this alkalinity as they are exposed to the air, or to the products of decomposing organic matters, from having absorbed a quantity of carbonic or other acids (sulphuric, humic, &c.) ; thus in some measure, according to the distance such waters have travelled from their springs, will their condition be changed until their alkalinity may give way to neutrality, or even acidity, either of which conditions are, as I have stated, unfavourable to the liberal deposition of silver along with gold from such waters. Hence it is apparent that, from the instant the waters percolating rocks or lodes leave them to form springs, &c., they are continually passing from a favourable condition to one eminently unfavourable for the deposition upon pyrites of what silver they may contain. Consequently, the deposition of gold from solution being, as we know, unaffected, or but slightly so (comparatively), by the condition of the solvent, the great purity of gold deposited from these surface waters is explained.

The above explanation of the greater purity of our alluvial or drift gold over gold found in the reef is, I think, much more plausible than that which attributes this difference to the interaction of solutions of gold upon the auriferous masses transported from the reef, whereby the silver of these masses is replaced by gold and so removed, leaving the mass correspondingly richer in gold. That this process can be continued until our largest auriferous masses can be thus affected throughout appears to me impossible when we consider the imperviousness of such metallic masses to liquids, and how nearly the atomic volumes of gold and silver approximate. That a superficial change, however, in this direction may occur is by no means improbable, but such would escape detection unless it were especially sought for. Thus the hypothesis advanced by Mr. Selwyn, as to the manner in which the nuggets of our drifts may have been formed, receives support upon all those points which appear of any importance.

That nuggets of some size may, however, be in a few instances transported bodily from these matrices into the drifts or water-courses is by no means improbable, but in this case they would, I think, partake of the usual quality of the reef gold of the country about, and so would be inferior in this respect to gold formed in the manner above described.

Whatever may be the origin, however, of any particular nugget, or of nuggets generally, when we consider the auriferous nature of many mine waters, also that of sea-water, together with decomposing and aggregating action of metallic sulphurets upon the gold of these waters, we cannot avoid the conclusion that gold is now being deposited and aggregated in many of our drifts, and that such depositions have been going on from remotest times.

In conclusion, the questions as to the source of the gold of our nuggets, the nature of the agencies by which it is dissolved, and the precise chemical state in which it exists in our auriferous waters, are subjects which it is not incumbent upon me to discuss here. I will, however, take leave to make a few observations upon them now.

As regards their source I think this is rather in gold as desseminated in certain of our slate, sandstone, or schist rocks, than in that of our reefs.

In reference to the nature of the solvent, I have shown* that sulphuretted hydrogen attacks gold at ordinary temperatures, forming a sulphide of the metal, and we know that all the sulphides of this metal we have to this time formed are soluble in alkaline sulphides ; therefore, as both these agents are generally present in waters situated at some depth in our rocks, we may very reasonably suppose

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* *Trans. N, Z. Inst.*, vol. iii., Art. XL.

* *Trans. N.Z. Inst.*, vol. iii., Art. XXX.

that a portion, if not all, of our gold has been brought into olution by these agents.

The state to which such auriferous solutions might pass when exposed to air and carbonic acid is not easy to determine, but of this we may be certain, that it could not well be one unfavourable to the exercise of the reducing properties of metallic sulphurets upon the gold compound present in them.

NOTICES OF BOOKS.

On the Right Use of Disinfectants. By H. LETHEBY, M.B., M.A., &c. London: Statham and Co.

THE substance of this pamphlet was originally read at a meeting of the Society of Medical Officers of Health, and has since appeared in our contemporary, *Public Health.* The author's expressed object, " to remove the many dangerous fallacies which beset the subject, and to arrest, if possible, the unblushing quackery which disgraces it," demands our heartiest approval. It is unfortunate that great public questions, such as the treatment of sewage and town-refuse of all kinds, the disinfection of hospitals, &c., attract the attention not merely of scientific men, but of " pushing " traders, who seize the opportunity for doing a good stroke of business at the general expense. Public ignorance may be called the demand to which quackery stands in the relation of supply, and on few subjects is such ignorance denser than on the nature and action of the substances classed together as disinfectants. We find instances of oxidizing and deoxidizing agents being used together, and of non-volatile bodies, like chloride of zinc and chloralum, being applied to disinfect the air. Dr. Letheby describes the best-known disinfectants under these heads—Mineral acids, organic acids, alkalies, haloids, mineral sulphates, permanganates, volatile oils, charcoal, dry earth, and other porous matters, air and water, and heat. Plain instructions are given concerning the properties of these disinfectants, their mode of application, and the circumstances to which each is adapted. Dr. Letheby, in accordance with the results obtained by Dr. Dougall, ranks the picric and benzoic acids as far more efficient than the carbolic and cresylic. It must, however, be remembered that picric acid is not volatile at common temperatures, and cannot, therefore, be applied for disinfecting the air of a sick-chamber, whilst the high price of benzoic acid must always be a bar to its common use.

We can scarcely agree with the author in his condemnation of solutions of deliquescent salts for watering the streets. We conceive it quite possible to apply them so as to keep the surface of a street or road damp, without becoming, as under the present system of watering, " slimy and slippery." Dust, instead of being blown about, would more likely be prevented. It would, indeed, be difficult to make a change in this respect which would not be for the better, especially in those parts of London where the streets are macadamised. The reader is reminded that we have no trustworthy evidence of the power of the permanganates to destroy contagion. To hang up a sheet, steeped with a solution of a permanganate, in a sick chamber is a total mistake. The permanganate will act upon the sheet, and upon particles of dust composed of dead organic matter much more readily than upon living spores or germs.

We recommend this book to the careful perusal of vestrymen, guardians of the poor, town councillors, and, indeed, of heads of families.

The Phosphates of Commerce; their Composition and Chemistry. By GEORGE JONES, F.C.S. London: H. K. Lewis.

THE author " having frequently heard the remark made by dealers in the important mineral known in the market by the general term phosphate, that it would be advisable if some well-known agricultural chemist would write an account of its composition and chemistry," has undertaken the task. Accordingly, he gives a general description of phosphates, phosphorites, and coprolites, which he informs us are " the fossil dung and bone of the huge mammal fish the ichthyosaurus." He then gives a brief account of the elements occurring in mineral phosphates. Next follows an account of the hydrometer, a notice of the combining proportions of the elements with which buyers and sellers of manures are chiefly concerned, and some useful remarks on sampling. An appendix gives the average composition of bone-ash, of Spanish phosphate, apatite, Sombrero-phosphate, animal charcoal, Nassau phosphate, Peruvian guano (in which we note the decline in the quality of that substance since its first introduction into commerce), a fish-manure, containing only 3·61 per cent of nitrogen, and a table of the mineral constituents of cereals. The author, in our opinion very judiciously, does not teach farmers and manure-merchants to become their own analytical chemists, an undertaking as impracticable as to render them capable of acting as their own lawyers, physicians, or engineers. Tables are given for calculating the money value of manures from the analysis, in which, however, no value is assigned to potash, although the author declares that carbonate of potash, and epsoms ought to form constituents of all artificial manures. There are also instructions for finding the amount of chamber-acid needed for dissolving phosphates in the manufacture of artificial manures. Notwithstanding certain inaccuracies, we consider that the work will be of service in enabling the agricultural chemist and his clients to understand each other the better.

Oratoric Verse on the Chemical Elements. By J. CARRINGTON SELLARS, F.C.S. Birkenhead: J. C. Sellars.

THIS pamphlet consists of specimen pages of the second edition of a work which appeared some time ago under the title " Chemistianity." Its object is to give an account of the elements in verse, the author believing that a knowledge of chemical facts may be thus most readily acquired and retained.

Butter; its Analysis and Adulterations, specially treating on the Detection and Estimation of Foreign Fats. By A. ANGELL and OTTO HEHNER. London: Wyman and Sons.

THE authors undertake to give what has been hitherto a desideratum, a chemical method for detecting and determining foreign fats used in the adulteration of butter. They conclude from their experiments that the volatile acids, instead of forming merely 2 per cent of the whole, as given by Bromeis in his analysis, amount to nearly 10 per cent. Their method is as follows :—Butter is repeatedly washed with hot water, dried and saponified in a flask with caustic potash till a clear transparent soap is obtained, which is effected in about four hours. The soap is then decomposed with dilute sulphuric acid, the liquid heated till the fatty acids floating on the top are just fused to a clear oily fluid, and then cooled again. The filtrate is distilled, and the acidity of the distillate estimated by means of a standard soda-solution, and calculated as butyric acid, $C_4H_8O_2$. Supposing the method correct, it is obvious that the addition to butter of any fat containing no volatile acids, such as suet, dripping, &c., will proportionately reduce the amount of butyric acid present in the distillate.

The value of the method turns, then, upon this point— Does the acid distillate consist of butyric acid, uncontaminated with any other body capable of saturating the soda solution? The authors have not performed, or at least have not described, any experiments to decide this question. They tell us that " the distillate never ceases to be slightly acid, and becomes strongly so when so great a concentration has been reached that the glycerin in

the liquid begins to decompose. To fill up with water is of no use, since no trace of acid distils over until the original concentration is re-obtained." Is it not possible that acrylic, acetic, and sulphurous acids may be present in greater or less quantity? We hope that the authors will bestow upon this matter a searching investigation.

Handbook of Natural Philosophy. By DIONYSIUS LARD-NER. (Hydrostatics and Pneumatics). New Edition, Edited by BENJAMIN LŒWY. London: Lockwood and Co.

DR. DIONYSIUS LARDNER—or "Diabolus Gander," as he is wickedly called in "Ten Thousand a Year"—though of very little merit in the sphere of original research, was an able and judicious compiler. His "Handbook of Natural Philosophy" has done good service, and we are not surprised at the appearance of a fresh edition like the present brought up to the standard of the day. The original work has been divided into five distinct treatises, of which the volume before us—to a great extent re-written by the editor—forms the second. For those "who desire to attain an accurate knowledge of physical science without the profound methods of mathematical investigation" this work is not merely intended, but well adapted. There are certain authors who instead of using mathematics as an instrument of research, invert the matter, and appear to treat physical and even chemical truths as mere pegs upon which to suspend a maximum of mathematical formulæ.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 7, August 17, 1874.

Report on a Memoir of M. P. A. Favre on the Equivalence and the Transformation of Chemical Forces.—The author begins by calling to mind that in 1853 he solved the following question:—Is the heat developed by the resistance to the passage of electricity in the conductors of a voltaic pair derived from the total heat which corresponds to the chemical action producing the current? He has established that the heat confined in the liquid of the pair, and that which springs from the resistance of the metallic circuit, are always complementary, furnishing the total heat due to the sum of chemical action, as Joule had already laid down by a kind of intuition. Rigorous experiments were, however, still wanting, and this proof has been furnished by Favre by means of his mercurial calorimeter, in which the battery was inserted. The author next examines the part of the various chemical actions which intervene in producing the calorific effects of a galvanic pair. He is thus enabled to check a view of Faraday's, which facts hitherto had not contradicted, *i.e.*, that the oxidation alone of the metal in a zinc-platinum pair develops the current, and that the solution of the oxide formed in the acid, plays no part. He has established, on the contrary, that the mere oxidation of the zinc does not suffice to account for the effects produced by the current, and that the heat of combination of the acid with the oxide of zinc must also be taken into consideration. From this memoir, the starting-point of the author's numerous ulterior researches, may be derived the correlation and equivalence of chemical duty, and of electro-dynamical duty, in accordance with the views of Joule, Mayer, Clausius, and Thompson. In a second memoir the author extends the conclusions of his first researches to an entire voltaic battery.

Manure for Vines Attacked by the Phylloxera.—Ch. Juge.—The mixture consists of—

Sulphate of ammonia	600 kilos.
Phosphate of lime (precipitated) ..	200 ,,
Lime	1200 ,,
Alkaline sulphates (2 parts) mixed with chloride of potassium (1 part)	300 ,,
Littery dung	15000 ,,
Or rags	2000 ,,

The dung is previously prepared by being spread out in layers, and each layer is sprinkled with sulphate of iron and precipitated phosphate of lime, and watered with the drainings of the dunghill. Between the vines holes are dug, 40 centimetres deep, 60 long, and 30 wide. At the bottom is placed the prepared dung, then the sulphate of ammonia, and then the alkaline salts. What is to be done with the lime the author does not state. This system has been very successful at Amilhac, near Bégiers.

General Procedure for the Analysis of the Elliptical Rays.—M. Croullebois.—A mathematical paper.

Use of the "Aërian Helix" as a means of Measuring the Intensity of Voltaic Currents, and the Mechanical Power of Electro-Magnetic Machines.—W. de Fonvielle.—A short note accompanying a model exhibited before the Academy.

Constitution of Clays and Kaolins.—Th. Schlœsing.—Analyses of the different parts of clays, as separated by levigation in alkaline water. The author finds that the particles of the plastic clays are in a more finely-divided state than those of the kaolins.

Certain Bismuthic Minerals from Meymac (Corrèze).—A. Carnot.—Native bismuth occurs in brittle irregular nodules, of a crystalline fracture, lamellar, white, and very bright. After exposure to the air it takes a reddish shade. It contains—

Bismuth	99·00
Lead	0·41
Iron	0·10
Antimony	0·15
Arsenic	0·09
Sulphur	0·06
	99·81

Oxide of bismuth is found enveloping the specimens of native bismuth. It is generally slightly hydrated and carbonated, and has the sp. gr. 9·22. It is opaque, semi-vitreous, and of a conchoidal fracture. Its colour is a pale yellowish green, brown in places. It is easily pulverised. In hydrochloric acid it dissolves with effervescence. It melts before the blowpipe, and easily yields a metallic bead upon charcoal. Its composition is—

Oxide of bismuth.. ..	96·70
Oxide of lead	0·55
Oxide of iron..	0·16
Sulphuric acid	0·15
Arsenic acid	0·13
Antimonic acid	0·22
Hydrochloric acid ..	0·20
Carbonic acid	0·68
Water	0·95
	92·74

This mineral resembles the tetra-dymite of Virginia, and the variety found in the Fichtelzebirge, and analysed by Suckow. It differs decidedly from the "bismuth ochre" of Lampadius.

Bismuthic Mispickel.—The external characters of this mineral are nearly the same as those of ordinary mispickel. The white fracture often takes a light rose tint on exposure to the air, and the presence of cobalt may be detected by the blowpipe. Three samples have been analysed:—

	I.	II.	III.
Iron	31·90	30·21	28·71
Bismuth	1·62	4·13	6·58
Lead	0·10	traces	0·10
Cobalt	0·16	0·76	1·07
Antimony	1·70	1·90	1·50
Arsenic	40·15	39·96	39·30
Sulphur	16·34	15·92	14·60
Gangue	6·10	4·90	5·70
Water and loss ..	1·93	2·22	2·44
	100·00	100·00	100·00

The gangue consists of a hydrated silicate of alumina, lime, and magnesia, partially soluble in acids. The mineral also contains 8 grms. of silver in 100 kilos., and a trace of gold not determinable.

Certain Apparatus for Fractionated Distillation.— MM. A. Henninger and J. A. Le Bel.—This paper requires an illustration.

Fluoxyborates.—M. A. Basarow.—The author has examined the fluoxyborates of soda described by Berzelius, and considers them mixtures, as by fractionated distillation he has resolved them into portions widely differing in composition.

Nature and Determination of the Sulphuretted Principles in Mineral Springs.—M. F. Garrigon.—An analysis of the waters of the Bayen spring, near Luchon.

Bulletin de la Societe Chimique de Paris, tome xxi., No. 12, June 20, 1874.

Use of Granulated Iron in Place of Granulated Lead in Rinsing Bottles.—M. Fordos.—The author points out the danger of using leaden shot in cleansing bottles intended to contain beverages, medicines, &c. In their stead he recommends fragments of iron obtained by clipping up iron wire, No. 16, 17, and 18 giving a quality suitable for phials, and No. 22 for wine bottles. These iron granules have been used on the large scale with very satisfactory results. If there is any fear of injuring the colour of choice white wines granulated tin may be used.

Compounds of Cerium.—Severin Jolly.—The author has prepared and examined—the crystalline chloride, $CeCl_3 + 7H_2O$; the chloro-mercurate,—
$$CeCl_3 + 4HgCl_2 + 10H_2O;$$
chloro-platinate, $CeCl_3 + PtCl_4 + 13H_2O$; chlor-aurate, $CeCl_3 + AuCl_3 + 13H_2O$; bromide, $CeBr_3 + \times H_2O$; brom-aurate, $CeBr_3 + AuBr_3 + 8H_2O$; fluoride, $2CeFl_3 + H_2O$; sulphocyanide, $Ce(CNS)_3 + 7H_2O$; sulphocyanide with mercuric cyanide, $Ce(CNS)_3 + 3Hg(CN)_2 + 12H_2O$; ferrocyanide of cerium and potassium,—
$$\left.\begin{matrix} Ce \\ K \end{matrix}\right\} Cy_6Fe + 3H_2O;$$
ferricyanide, $Ce_2Cy_{12}Fe_2 + 8H_2O$; platino-cyanide,—
$$2CeCy_3 + 3PtCy_2 + 18H_2O;$$
nitrate, $(NO_3)_3Ce + 6H_2O$; perchlorate, $(ClO_4)_3Ce + 8H_2O$; iodate, $(IO_3)_3Ce + 2H_2O$ (a periodate does not appear to exist; sulphates—a, $(SO_4)_3Ce_2 + 5H_2O$; b,—
$$(SO_4)_3Ce_2 + 6H_2O;$$
c, $(SO_4)_3Ce_2 + 8H_2O$; d, $(SO_4)_3Ce_2 + 9H_2O$; e,—
$$(SO_4)_3Ce_2 + 12H_2O;$$
Double sulphate of cerium and potassium,—
$$(SO_4)_3Ce_2 + 3SO_4K_2;$$
sulphate of cerium and ammonium,—
$$(SO_4)_3Ce_2 + SO_4(NH_4)_2 + 8H_2O;$$
sulphate of cerium and sodium,—
$$(SO_4)_3Ce_2 + SO_4Na_2 + 2H_2O;$$
seleniate—a, $(SeO_4)_3Ce_2 + 6H_2O$; b, $(SeO_4)_3Ce_2 + 9H_2O$; c, $(SeO_4)_3Ce_2 + 12H_2O$; seleniate of cerium and potassium, $(SeO_4)_3Ce_2 + 5SeO_4K_2$; seleniate of cerium and ammonium, $(SeO_4)_3Ce_2 + SeO_4(NH_4)_2 + 9H_2O$; seleniate of cerium and sodium, $(SeO_4)_3Ce_2 + SeO_4Na_2 + 5H_2O$. Selenite, $(SeO_3)_3Ce_2 + 3H_2O$; b, $(SeO_3)_2CeH + 2H_2O$; hyposulphate, $(S_2O_6)_3Ce_2 + 24H_2O$; sulphite,—
$$(SO_3)_3Ce_2 + 3H_2O;$$
carbonate, $(CO_3)_3Ce_2 + 5H_2O$; carbonate of cerium and potassium, $(CO_3)_3Ce_2 + CO_3K_2 + 3H_2O$; carbonate of cerium and sodium, $(CO_3)_3Ce_2 + 2CO_3Na_2 + 2H_2O$; ortho-phosphate, $PO_4Ce + 2H_2O$; pyro-phosphate,—
$$P_2O_7HCe + 3H_2O;$$
formiate, $(CO_2H)_3Ce$; acetate, $2(C_2H_3O_2)_3Ce + 3H_2O$; oxalate, $(C_2O_4)_3Ce_2 + 9H_2O$.
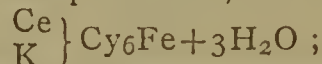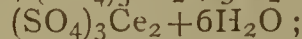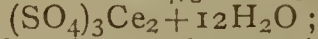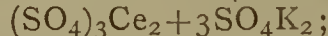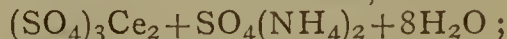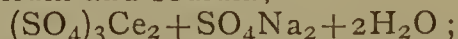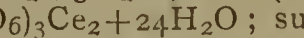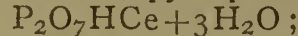
Apparatus for the Continuous Preparation of Chlorine in the Cold.—M. A. Mercet.—Chloride of lime in contact with hydrochloric acid may be used for liberating chlorine at will. The apparatus is that of M. Deville, and consists of two flasks connected by an india-rubber tube, one containing a mixture of 3 parts by measure of ordinary hydrochloric acid and 1 of water, and the other containing the chloride of lime, placed upon a layer of broken glass. The chloride of lime is first made into a thick paste with water, and is then rolled with the hands into egg-shaped masses the size of a nut. These are then exposed to the air for some hours before use.

Process for Preparing Active Amylic Alcohol.— J. A. Le Bel.—The author set out with an attempt to ascertain the cause of the anomaly of the chloride of amyl, which is lævo-rotatory, whilst the iodide and bromide of the same radical are dextro-rotatory. Having prepared chloride of amyl by Balard's method, the rotation was found not left, but *nil.* This distinction may be due to the elimination by the hydrochloric acid of a certain amount of lævo-rotatory alcohol which had remained in the chloride. To remove the last traces of amylic alcohol remaining in the chloride, agitation with sulphuric acid and treatment with perchloride of phosphorus were successively employed. The two products were both dextro-rotatory.

Means of Distinguishing Phormium from Hemp, Flax, &c.—M. E. Vitrebert.—The sample is immersed in the aqueous solution of an aniline colour, magenta or blue (though with the latter the reaction is less distinct), containing about a decigramme of colour to a litre. It is left in the solution for some hours in the cold, or for some seconds at 70° to 80°. It is then washed in water and examined. All the fibres of the phormium will be found decidedly coloured, whilst those of hemp or flax will be white. This test is more sensitive than that with nitric acid, and previous bleaching does not modify the reaction. If, after contact with the colouring matter, the swatch is washed with soap lyes the distinction is still more striking, for the phormium remains red, whilst hemp is very white. Ammonia may also serve to distinguish phormium from hemp when the fabric has been bleached. If the swatch is steeped in this alkali the phormium resumes its natural colour, whilst hemp remains white.

Action of Sulph-Urea and Bisulphide of Carbon on Argentic Urea.—M. J. Ponomareff.—The reaction between the former body and argentic urea may be represented by the equation—
$$CON_2H_2Ag_2 + CSN_2H_4 = Ag_2S + CON_2H_4 + CN_2H_2.$$
With the sulphide of carbon the reaction may be expressed by—$CON_2H_2Ag_2 + CS_2 + H_2O = N_2S + COS + CON_2H_4.$

Researches on the Preparation of Organo-Metallic Compounds of the Hydrocarbons Belonging to the Series C_nH_{2n}.—Donato Tommasi.—Not adapted for abstraction.

Action of Chloride of Benzyl upon Camphor.— Donato Tomassi.—A continuation of the author's former paper on the same subject.

Promiscuous Notes.—Fr. Stolba.—
Reduction of Selenious Acid by Glucose.—If selenious acid is boiled in a flask with glucose and an excess of potash no selenium is deposited, but as soon as the solution is exposed to the air a red scum is formed, which gradually increases. It appears that boiling alkalies redissolve selenium. These reactions may, perhaps, serve for separating selenium and tellurium.

Reduction of Telluric Acid by Glucose.—When glucose is added to a solution of tellurate of ammonia, treated at

a boiling heat with an alkali or an alkaline carbonate till the ammonia is expelled, a colouration appears, followed by a deposit of tellurium in black flakes. This deposit is not as rapid as with tellurous acid, but the precipitation of the tellurium is complete. This reaction allows of the preparation of pure tellurium.

Purification of Chlorine.—The author frees chlorine from hydrochloric acid gas by washing, first in a moderately concentrated solution of sulphate of copper, and then in water.

Preparation of Carbonic Acid by Fermentation.—The author dissolves raw sugar in 4 parts of water by weight, and adds ½ per cent in volume of yeast. The fermentation sets in after a few hours, and may be regulated by raising or lowering the temperature. If it ceases more sugar may be added, or, in case of need, a little more yeast. The vessel must be spacious.

Extraction of Thallium.—To extract thallium from the mud of the lead chambers the author sprinkles it with sulphuric acid, exhausts with boiling water , and evaporates the solution to crystallisation, after adding a little sulphate of alumina. The last mother-liquors are precipitated with hydrochloric acid. The crystals of thallium alum may be re-crystallised, and then decomposed by means of zinc; or the thallium may be precipitated as chloride.

Optical Property of Crystals of Sulphate of Copper.—If we receive the solar light reflected by a large crystal of sulphate of copper upon a sheet of platinum or tin plate, placed at a small distance from the crystal, the sheet assumes the colour of metallic copper upon the part which receives the reflected light.

Action of Fluosilicic Acid upon Salts of Cerium.—When this acid is added to certain salts of cerium, lanthanum, and didymium, especially the acetate, there appears a turbidity, or an amorphous precipitate. This does not appear with other salts, except after addition of sulphate of copper. The fluosilicates thus obtained are sparingly soluble in water, acetic acid, and fluosilic acid, but dissolve in most mineral acids. Alcohol facilitates their precipitation.

Crystallisation of Tin.—A fine crystallisation of tin is obtained as follows:—A platinum capsule is covered with an outer coating of paraffin or wax, leaving the bottom only uncovered. This capsule is set upon a plate of amalgamated zinc in a porcelain capsule. The platinum is then filled completely full of a dilute and not too acid solution of chloride of tin, whilst the porcelain is filled with water acidulated with 1-20th of hydrochloric acid, so that its surface comes in contact with the surface of the liquid in the platinum. A feeble electric current is set up, which reduces the salt of tin. The crystals formed after a few days are well developed. They are washed with water and dried quickly.

Determination of Cyanide of Potassium in Silver Baths.—G. C. Wittstein.—The object of this determination is to know the quantity of *free* cyanide which exists in a silver-plating bath, and consequently the amount of silver which must be added to the bath to restore it to activity. The method consists in transforming the cyanide into acetate, dissolving the latter in absolute alcohol, and converting it into chloride, which is weighed. But all the potassium contained in the bath is weighed in the state of free cyanide of potassium, of double cyanide, of carbonate, and of cyanate, and by these special operations its divers elements are determined.

Determination of Total Potassium.—10 c.c. of acetic acid are added to 20 c.c. of the silver bath. It is evaporated to dryness, the residue digested for twenty-four hours with absolute alcohol, the liquid decanted, the deposit washed with alcohol, evaporated almost to dryness; 5 c.c. of hydrochloric acid are added, it is dried, and the chloride of potassium obtained is weighed (A).

Determination of Double Cyanide.—The silver is precipitated with sulphide of ammonium, and the sulphide of silver is weighed. From its weight the corresponding quantity of cyanide of silver, cyanide of potassium, and chloride of potassium (B) are calculated.

Determination of the Carbonate.—Precipitate with chloride of calcium, and weigh the carbonate of lime, from which can be calculated the carbonate of potash, and the weight (C) of chloride of potassium which it has yielded in the first operation.

Determination of Cyanate.—Cyanide of potassium when melted contains cyanate in the proportion—

$$7KCy + 3CyKO,$$
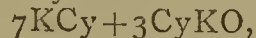
or 34·8 per cent. In every 100 of potassium furnished by the mixture, 30 are yielded by the cyanate. After having therefore, deducted from the total A the weights B+C, 30 per cent must still be subtracted to find the weight yielded by free cyanide. The method is sufficiently exact for practical purposes.

Utilisation of Tin Waste.—M. Kuenzel.—The process includes the following operations:—Boiling the waste with water acidulated with hydrochloric and nitric acid, until the tin is completely dissolved. To 1000 kilos. of waste containing 5 to 6 per cent of tin, 300 kilos. of crude hydrochloric acid and 30 kilos. of crude nitric are used, with water enough to cover four-fifths of the heap. The operation is carried on in tanks of wood or brick, 3 metres cube, lined with a composition of 2 parts of sand and 1 part of melted sulphur, and heated by steam. The action lasts from thirty to forty-five minutes. The liquid is then run off, the scrap-iron washed, and the washings used in treating the next lot. The tin is precipitated in a spongy state by means of scrap-zinc, 70 parts of which serve for 100 of tin. The precipitated mass is washed, and at once dissolved in hydrochloric acid. There remains a mass composed of chloride of lead and oxide of tin; this is mixed with double its weight of coke, and heated in a zinc furnace. Chloride of tin distils over, and metallic lead remains. The iron scrap, freed from tin, can be used in the manufacture of copperas, or in metallurgical operations. The author subjoins figures which show a fair working profit on the process.

Reimann's Farber Zeitung, No. 32, 1874.

This number contains a notice on the utilisation of old vat-nets which contain from 5 to 15 lbs. of indigo.

There is a notice of Australia fibre, a textile vegetable matter preferable to jute and possessing a greater affinity for colours; receipts for a Nicholson blue on this fibre; a bright and fast brown on cotton yarn; a fast black on mixed garments; a black on linen; and a continuation of the instructions for the hydrosulphite indigo process. Next follows an article for dyeing "Beider-wand," a provincial German tissue of wool and linen, and an account of a new apparatus for steaming printed pieces.

G. Witz ascribes the turning green of aniline blacks in presence of acid oxidising agents merely to the acid, and not to any deoxidisation or even oxidation.

No. 33, 1874.

This number contains general instructions on dyeing with aniline colours, containing nothing remarkable; a continuation of the essay on "Beider-wand," and of the instructions for the hydrosulphite process; receipts for a light olive on cotton yarn; for a pansy on vienna; for printing a fawn on calico; and for the galvanic deposition of copper on iron cylinders for printing.

No. 34, 1874.

This number contains a continuation of the article on dyeing with anilines; a notice of a new finishing machine; receipts for a ponceau, a grey, and a maize on silk, and a reddish brown on woollen yarn; a continuation of the paper on "Beider-wand;" a notice of the state of the cotton manufactures in the French Department of Seine Inferieure; and a description of Fohl's apparatus for the recovery of benzol, &c., used in extracting fatty matters.

THE CHEMICAL NEWS.

VOL. XXX. No. 777.

ON SULPHUR DI-IODIDE.

By R. W. EMERSON MACIVOR.

WHEN an intimate mixture of sulphur and iodine, in the proportion of one atom of the former element to two of the latter, is heated, there results a dark-coloured substance, somewhat resembling in appearance native antimony trisulphide, or stibite, which is generally considered to be sulphur di-iodide, $''''S''I_2$.

It smells very strongly of free iodine, and when heated *in vacuo* yields a sublimate composed of almost pure iodine and a residue of sulphur. It is insoluble in water, but dissolves in carbon disulphide, yielding a solution having the magnificent violet colour characteristic of a solution of free iodine in this menstruum, and leaving, on evaporation, a residue in which, on examination with a magnifying-glass, crystals of sulphur and iodine are discernible. By continued washing with absolute alcohol, the whole of the iodine contained in the substance may be abstracted, and a residue of sulphur left, which dissolves in carbon disulphide. Ether also dissolves out the iodine.

As the properties enumerated above are those which would be expected to characterise a mechanical mixture of sulphur with iodine, I am much inclined to doubt the compound nature of the product obtained by simply heating the two elements together.

Glasgow, 1874.

NOTES ON ALLOXANTIN AND MUREXIDE.

By JAMES REOCH, M.A., M.B.

WHEN urine is boiled with an acid solution of molybdate of ammonium, it invariably turns green. If about 4 c.c. of urine are used, and two drops of the molybdate and two of strong HCl, the colour is produced at once on boiling, but deepens for some time afterwards. Now, four reagents are mentioned in chemical works as capable of producing the blue oxide of molybdenum, but of these nascent hydrogen alone acts speedily and completely. To this alloxantin must be added, as I have always found it to reduce the molybdate at once, more especially when hot, and it is to this body that I believe the green colour produced in urine is due, the blue colour proper being mixed with yellow urine; at any rate, none of the ordinary constituents of urine, urea, uric acid, hippuric acid, or salts, either separately or combined, can reduce the molybdate; but, whether this be so or not, the test is of valuable application in determining the constitution of alloxantin, for the latter gives a violet precipitate with baryta- or lime-water, and if this be thrown on a filter, washed, and treated with dilute HCl or H_2SO_4, chloride or sulphate of barium or calcium will be formed, and if the filtrate be now tested for alloxantin by the acid molybdate, nearly as much will be found as was originally used. This experiment seems decisive in regard to the acid character of alloxantin, and it is further confirmed by the fact that it is acid to test-paper in a proportion equal to its combining weight. I have added lime-water to a solution of a weighed quantity of alloxantin, and then dilute H_2SO_4, by which I have obtained an acidity of 297 as the mean of several experiments. This result approximates to 322, sufficiently allowing for the loss which invariably occurs from the decomposition of these organic compounds by the very boiling required to effect their solution to show that it is a dibasic acid. It is,

however, easily decomposed by KHO or NaHO by prolonged boiling, probably with the production of a carbonate, for the acid molybdate reaction is soon negatived, and baryta-water gives a white precipitate which effervesces on adding HCl. Much dispute has arisen as to the nature of murexide, on which I have a few facts to contribute. When pure and dry murexide is treated with strong HCl in the proportion of about 2 c.c. to 150 m.grms., and the mixture stirred with a glass rod, the microscope will reveal crystals of alloxantin instead of the prisms of murexide, the process of decomposition may be watched under the microscope, when the prisms will be seen to break up into a multitude of smaller prisms, which are speedily dissolved; in a short time, larger or smaller crystals of alloxantin start into view. Again, if 1 grm. of murexide be dissolved by boiling with 3 ozs. of strong HCl, and 3 ozs. of H_2O be added, beautiful crystals of alloxantin are deposited in twenty-four to forty-eight hours; if a larger quantity be used, the precipitate is delayed. In this way, about 30 or 40 per cent can be obtained.

Now, when 150 m.grms. of murexide are boiled with 2 c.c. of HCl till solution is effected, and rapidly cooled, a precipitate takes place in a few minutes, which is sometimes called murexan, but which, from what I have said above, must contain a large quantity of alloxantin; in fact, the crystals are easily recognised as flat plates having an angle of about 105°, and giving the acid molybdate test. But when murexide is dissolved in KHO, and dilute H_2SO_4 added, a precipitate is formed which is not alloxantin, though containing a small quantity, but is really murexan. These facts may serve to explain the constitution of murexan, as being composed of uramil with a greater or less quantity of alloxantin, and may account for the varying analyses of that body. Though alloxantin is thus readily got from murexide, the latter is not a compound of the former with NH_3, for HCl invariably gives a yellow solution with murexide, showing that another body is formed besides NH_4Cl and alloxantin.

Murexide is one of the most intense of pigments; a test-tube containing only 1 part in 12,000,000 looks decidedly pink when placed on a sheet of white paper, and this fact may account for the common idea that it is a very unstable body. No doubt it is easily decomposed, but the yellow pigment which HCl transforms it into is several hundred times less intense as a pigment, and it may therefore easily be overlooked when only small quantities are operated on. That murexide is not of weak constitution is proved by the very mode of its production, by oxidising uric acid; and here I may correct a common error. It is said that, when uric acid is heated with HNO_3, a red residue is left, which becomes crimson by the vapour of NH_3. The fact is, that the red residue is impure murexide, and becomes crimson merely by H_2O; the only use of NH_3 is where the residue is not quite dry, for a trace of HNO_3 would easily destroy the colour, and the NH_3 would neutralise this; but anyone can satisfy himself that murexide is produced without the NH_3. It is also produced in many other ways; for the red colour which alloxan assumes in the air or when heated is due to this cause, and by cautious treatment with strong HCl I have obtained alloxantin crystals from it; so, also, alloxantin in moist air turns pink. Only a small proportion of murexide is got from these bodies, from uric acid, for example, not above $\frac{1}{12}$th part; but its colour is so intense that a small quantity readily shows itself. It is usually said that murexide contains 3 or 4 per cent of H_2O; but this is quite unessential, for even when heated to carbonisation the prisms for the most part retain their form, so that it can be dried without decomposition. It is also said to redden litmus, but it dyes all kinds of paper, so that it should be treated with dilute H_2SO_4 till decolourised, and then with NaHO. When this is done, it will be found that the murexide makes no difference in the quantity required for neutralisation; it is, therefore, itself a salt or neutral body. By heating it with NaHO first, till decolourised, and then using H_2SO_4, it is found that at least one equivalent of NH_3 has been given off; but the

result is not quite uniform, probably owing to the fact that the decomposition is complex, and that small quantities of NH_3 are given off from some of the other products.

CROISSANT AND BRETONNIERE'S NEW COLOURS.

THESE new dyes are now manufactured on a large scale, and have ceased to be regarded as mere chemical curiosities. They are distinguished for their great tinctorial power, their remarkable permanence, and their cheapness. Except red, blue, green, and their modifications all colours can thus be produced. Very fine results are obtained by mixing the new dyes with the woods, which, however, will be almost superseded by the former. The cost of manufacture is so trifling that a cwt. dye from sawdust—which will prove a substitute for logwood—costs only thirty shillings, whilst the equivalent amount of extract of logwood costs £7 10s. Extract of chestnut, 1·2 fr. per kilo., is only raised in price 5 centimes, extract of fustic 20 centimes, and extract of logwood 68 centimes by conversion into the new colours, whilst their tintorial power is rendered three or four times greater. To produce a good grey on 10 kilos. of material, 0·25 kilo. of sawdust is sufficient. In permanence the new colours greatly outstrip those now in use. They are not affected by light, acids, oxalate of potash, nor even by hot soda-lye. Concentrated chlorine alone attacks them. When used along with other colours they render the latter more permanent, especially the aniline preparations. Varieties of shade are not produced by mixtures, but by regulating the temperature to which the colour is exposed in the course of manufacture. The colours have been used for some time in various establishments in Lille, Roubaix, Cholet, Rouen, and Laval Garne, and have given great satisfaction.

The process of dyeing is as follows :—The colours are dissolved in hot water, and the goods are steeped and turned in the solution from 30 to 45 minutes. They are fixed by a hot solution of bichromate of potash, in which they are left for about 15 minutes, washed with pure water, treated—in case of wool and silk—with acid to remove excess of alkali [Should not this process come after the next described operation ?], and then placed in an alkaline bath made up with ½ kilo. soda to 45 litres of water, washing finally with clear water.—(*Der Arbeitgeber.*)

The following additional particulars are taken from a pamphlet issued by the "Patent Farben-Fabrik" of Göttingen—an establishment devoted to the manufacture of the new colours.

The Société Industrielle of Mühlhausen has found that these colours attach themselves permanently to the fibre, by the mere evaporation of the water in which they are dissolved,—a circumstance of great importance in calico-printing. All the colours are soluble in water, and are precipitable by mineral as well as organic acids and metallic salts. The colours have a remarkable affinity for both animal and vegetable fibres, upon which they have no injurious action.

The new colours dye wool, silk, linen, and cotton equally well. Hence mixed goods can be dyed in one operation without appearing checkered, the colour producing one and same tone of equal intensity, both upon the weft and the warp. In dyeing, after the colour and the chrome baths, the goods are passed through a boiling soda-bath, and washed in abundance of water. Animal fibre may require the addition of a little acetic acid to remove the last traces of alkali. Other metallic salts may be used instead of chrome, according to the particular effect desired.

The following receipts have been in successful use in the works of the inventors. They are all adapted to 20 kilos. of linen or 13 of cotton. The numbers are the distinguishing marks of different dyes.

1. *Greys.*

No. 1. 268 grms. in 90 litres water free from lime.
No. 1. 670 ,, ,, ,, ,,
No. 1. 1200 ,, ,, ,, ,,

2. *Yellowish Shades.*

No. 7. 400 grms. in 90 litres water free from lime.
No. 7. 1200 ,, ,, ,, ,,

3. *Other Modes.*

No. 1. 670 grms.⎱ in 90 litres water as above.
No. 11. 667 ,, ⎰
No. 11. 400 ,, ,, ,, ,,
No. 11. 800 ,, ,, ,, ,,
No. 11. 600 ,, ⎱ in 90 litres water.
No. 13. 2 litres⎰
No. 13. 4 ,, ,, ,,
No. 13. 3 ,, ,, ,,

4. *Browns and Blacks.*

No. 15. 1200 grms. in 90 litres water.
No. 15. 400 ,, ,, ,,
No. 18. 1200 ,, ,, ,,
No. 18. 400 ,, ,, ,,
No. 1. 700⎱ ,, ,, ,,
No. 11. 1000⎰
No. 1. 100 ,, ⎱ ,, ,,
No. 13. 1½ litres⎰

Chrome-bath for the above quantities.

Bichromate of potash 105 grms.
Water ,, 80 litres.

Soda-bath.

Soda 1 kilo.
Water 80 litres.

The water must in all cases be free from lime.

We may add that we have been favoured with samples of several of the colours, and as far as laboratory experiments can go we find that their properties are really as described.

ON ANTHRACEN AND ALIZARIN.*

By FREDERICK VERSMANN, Ph.D.,

IN accepting the invitation to lecture before you on one of the most important and most interesting recent chemical discoveries, I had to consider whether I should treat my subject in preference from a practical or from a scientific point of view.

Looking at the object for which this series of chemical lectures has been arranged by the Council, and believing it to be decidedly of a practical nature, I have thought it best to confine myself as much as possible to the practical side of my subject, and to consider the theoretical part only so much as may be necessary for a general understanding. I have done so all the more readily because I shall thereby be best enabled to point out the great advantage and the absolute necessity of constant scientific investigation of apparently very simple manufacturing processes, and also because I am anxious to invite a discussion on several practical points, which are surrounded by much uncertainty ; and I should be much pleased if such discussion should assist in clearing away some of the uncertainty and dissatisfaction at present attached to the true value of an article which suddenly has assumed such vast importance.

I may at once remark that, although my paper is " On Anthracen and Alizarin," I have found it impossible to do full justice to both subjects in one evening. I shall therefore limit myself to-night chiefly to the consideration

* Read before the Society of Arts, Chemical Section.

of anthracen, and I shall touch but lightly upon its conversion into colouring matter; but I hope I may have at some future time an opportunity given me to fully discuss the various processes which produce these chemical changes, and result in such splendid and beautiful compounds.

In tracing the history of anthracen, we find that the two great French chemists, Dumas and Laurent, in 1832, first obtained it from the last fractions of the distillation of coal-tar; they exposed the oily matter to extreme cold, when a crystalline deposit separated, which was pressed and washed with alcohol; the residue was further purified by re-distillation, crystallisation, and sublimation, and was then submitted to chemical investigation. Dumas and Laurent assigned to the compound thus obtained the formula $C_{15}H_{12}$, and as this is half as much again as naphthalen, $C_{10}H_8$, they named the new substance para-naphthalen. But this chemical composition and the low melting-point, which was found to be 180° C., convincingly prove that the substance must have been a mixture of several hydrocarbons, and not a definite chemical compound.

Laurent afterwards submitted the substance to fresh investigations, and obtained several interesting derivatives, but, as Professor Kopp suggests in his exhaustive historical memoir on "Anthracen and its Derivatives," published in the *Moniteur Scientifique*, Laurent evidently had at his disposal only small quantities of the impure hydrocarbon; he therefore could not determine the true composition of the substance, which he now named anthracen.

At present it is generally acknowledged that the compound these two chemists investigated was not pure, and that their formula is not correct; it is therefore the more surprising that Girard and De Laire, in their "Traité des Dérivés de la Houille," published only last year, repeat with strange tenacity Dumas and Laurent's antiquated statements; they treat para-naphthalen as an existing definite compound of the formula $C_{15}H_{12}$, although they have nothing new to add in support of their isolated opinion; on the contrary, they confess that the substance is little known, that the investigations are very old, and made very likely not with a pure compound, but with a mixture of para-naphthalen and anthracen.

Fritsche described, in 1857, a hydrocarbon, obtained from coal-tar, which he found in many respects closely to resemble Laurent's anthracen, but which had a melting-point of 210° to 212° C., and the formula of which he found to be $C_{14}H_{10}$.

Anderson published, in 1862, a most searching investigation of the higher hydrocarbons from coal-tar; he separated anthracen in great purity, obtained many of its most important derivatives, prominent amongst which stands his oxanthracen, or anthrachinon, which, however, had already been obtained by Laurent. Anderson retained Laurent's name of anthracen, but confirmed Fritsche's formula and melting-point.

So far, then, the hydrocarbon had been separated from coal-tar only, but in 1866 Limpricht demonstrated its formation, resulting from the decomposition of chloride of benzyl by water in a closed vessel at 180° C.; and in the same year Berthelot commenced the publication of his masterly researches on the action of heat upon the hydrocarbons, their origin, character, and composition; he pointed out the circumstances under which anthracen is formed by the action of heat upon the several more simple hydrocarbons; he found that toluol alone, or a mixture of styrol and benzol, or of benzol and ethylen, passed through a red-hot tube, furnished anthracen.

Berthelot's and Limpricht's results are so far exclusively of theoretical interest, at present at least, there does not appear any chance of their investigations being capable of practical application. Berthelot also described the extraction of anthracen from coal-tar, its purification, and its characters, and he confirmed Anderson's results. So far, all these investigations were of a purely scientific character, but in 1868 two German chemists, Graebe and Liebermann, succeeded in reducing alizarin, extracted from madder, and in obtaining therefrom a hydrocarbon which corresponds in all its properties to Anderson's anthracen.

This, then, is the starting-point of one of the greatest revolutions in chemical industry, because, after having obtained anthracen from alizarin, it was comparatively easy to convert anthracen into alizarin, and thus the possibility was given of producing, by artificial means, one of the most important and most ancient natural colouring matters.

Several German manufacturers of aniline dyes at once commenced the solution of this problem, with more or less rapid success, and, although scarcely five years have elapsed since the first laboratory experiment was made, to-day we see a number of large works producing vast quantities of the artificial colour. The first and most important question became, of course, the sufficient supply of anthracen.

It is difficult to realise the idea that an article which was but yesterday unknown and useless, and of no commercial value whatever, should to-day be most eagerly sought after, and should command a high price. Such, however, is the case with anthracen, which has suddenly risen to greater importance than any of the other products of the distillation of coal-tar. True, the application of benzol and its homologues imparted to this series of hydrocarbons an importance previously unknown, but it becomes almost insignificant if compared with the position anthracen has so suddenly, and no doubt permanently, assumed.

Before attempting to give a description of the manufacture of anthracen, I may be allowed for a moment to go a step further back, to draw your attention to the formation of tar, from which anthracen is obtained.

I need scarcely say that tar is one of the by-products in the manufacture of illuminating gas. Coal, heated in a closed red-hot retort, is split up into a series of volatile and non-volatile compounds; the last remain in the retort as coke, while the volatile compounds are carried away by means of an exhauster; they pass through the ascension pipe at one end of the retort into an hydraulic main, and then into the condensers. These are large upright syphons, and as the volatile compounds are made to pass through a whole series they are cooled. The permanent gases pass on to be further purified and to be stored in the gas-holders, while other products, carried away so far in the form of hot vapour, are condensed in the liquid form, and accumulate at the bottom. These liquid products consist chiefly of tar and water, which separate on standing; the tar is run off into the tar-wells, and is ready for further treatment.

In drawing your attention to the following table, in which I have endeavoured to illustrate and to follow up the ultimate separation of anthracen from tar, but, starting with coal and its conversion into gas and its by-products, I need scarcely remark that I could not have intended to give a complete representation of all the different compounds obtained in the operation, but that I have simply grouped them together in as few divisions as possible:—

PRODUCTS OF DESTRUCTIVE DISTILLATION OF COAL.

COAL

Gas. Liquid. Solid coke.

Tar. Ammoniacal liquor.

Light oil. Heavy oil. Pitch.

Oil. Solid hydrocarbons. Oil Solid hydrocarbons. Coke

Naphthalen, Anthracen. Naphthalen, Anthracen.
Chrycene, &c. Chrycene, &c.
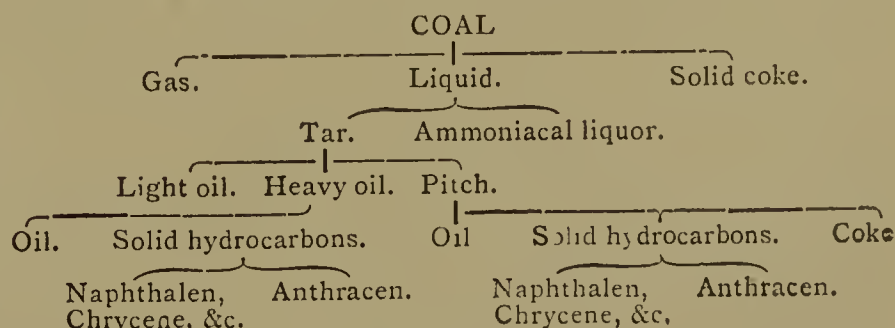
We have already seen that coal submitted to destructive distillation yields gaseous, liquid, and solid products. Passing over the gas and the solid, we separate the liquid into tar and into water containing much ammonia, and

which is therefore called ammoniacal liquor. The tar submitted to fractional distillations yields light oil, heavy oil, and pitch. These, I repeat, are only broad divisions, as obtained by the first distillation of tar. The oils contain several series of liquid hydrocarbons, the most important of which is the benzol series; a series of bases containing nitrogen, of which aniline is the type; a series of acids, foremost amongst which is carbolic acid; and, lastly, a whole series of hydrocarbons, most prominent amongst which we find anthracen.

Perhaps I ought to have given a complete list of all these compounds, with some of their characteristic physical properties, but as their number is very considerable—more than sixty at least,—I have limited myself to the solid hydrocarbons as the only ones bearing directly upon our subject. These we shall have to consider later on, when speaking of the impurities which accompany anthracen.

The pitch resulting from tar is further divided, ultimately yielding again anthracen. This is a process I shall have to speak of separately.

The manufacture of anthracen appears at the first moment to be extremely simple, an impression which, unfortunately, has taken hold of many tar distillers, and which accounts for the low quality of very large quantities of anthracen sold.

The well-known process of tar distilling, so the formula runs, is carried out as usual, and the last 10 or 15 per cent of the products of the distillation are set aside and allowed to stand for some weeks, when a crystalline deposit of solid hydrocarbons separates; this is freed as much as possible from the adherent oil by filtration, pressing, or other mechanical means, when the residue, more or less dry and more or less impure, is ready for sale.

This, no doubt, is the necessary beginning of the process, which, however, should be further followed up, and ultimately result in an article of such purity that it might at once be converted into colouring matter, *i.e.*, an article containing at least 75 or 80 per cent of pure anthracen.

True, in the early days of anthracen—and that is but four years ago—the alizarine makers were well contented to get anthracen of any quality, however low in percentage, because the success and very life of the new dye depended upon the possibility of getting large quantities of a hitherto unknown article. At that time the alizarine-maker bought what he could get, often perhaps not knowing himself the value of the articles bought; but it is evident he did so unwillingly and only of necessity, as is clearly shown by some remarks of Dr. Gessort's, one of the earliest and most successful manufacturers of alizarin, who wrote about three years ago as follows:—

"It is to be regretted that the tar distillers are not more careful in the manufacture of commercial anthracen. The manufacturer of alizarin has not at his disposal the necessary plant required for the purification of crude anthracen; at all events, he loses much time, and has no use for the oily residues resulting from the purification.

"The tar distillers, on the other hand, can always use these by-products along with their other oils. They ought to take the greatest care in the pressing of the well-filtered and drained anthracen, by using powerful hydraulic presses and by pressing, first cold and then hot, as strongly as possible. Such crude well-pressed anthracen is readily powdered and passed through a sieve, and in this state of fine division it may be treated with petroleum spirit, boiling between 70° and 90° C., and after sufficient washing it may again be submitted to strong pressure.

"The price of crude anthracen of good quality is sufficiently high and remunerative to induce the tar distiller well to study the rational manufacture of the article, and to devote all his care to it."

Every word of these remarks, written three years ago, holds good even to-day, because only very few distillers are aware of the profit to be derived from purifying their crude product and thus obtaining a high-class article. It is also true that, now that the question of producing large quantities of anthracen has been settled, the alizarin

manufacturer buys but unwillingly a low per cent article and we see a new class of manufacturers spring up, which stand between the two former ones, viz., anthracen purifiers, who buy the crude anthracen and supply the consumer with an article of the desired purity. Of these anthracen purifiers there are several in Germany and at least one in England; and nothing could speak more strongly in favour of my argument—that the first manufacturer should also be the purifier—than the fact that other people find it profitable to take up the purification as a separate business.

Of course, I do not for a moment under-estimate the difficulties connected with the subject; on the contrary, I am anxious to point them out, and to express my strong opinion that the whole manufacture must be looked upon, not so much as a mechanical, but rather as a chemical, operation,—that it requires a chemist's constant care and scientific investigation, without which only partially satisfactory results can be ascertained; because, after first having obtained the crude product, what is the question to be solved? Is it not the separation of one substance from a number of other substances extremely similar in their physical properties; and can such separation be successfully carried out, especially on the manufacturing scale, without an intimate acquaintance with all these substances? Certainly not; and, moreover, the production of the first article ought to be based upon scientific principles as well, because we must assume—and there is little doubt of this view being correct—that the greatest part of these solid hydrocarbons does not exist ready formed in the tar, is during the distillation not simply vapourised and afterwards again condensed, but that it is the product of decomposition by heat of more simple compounds; and, if this be so, will not the study of the effects of heat under varying circumstances become of the utmost importance, and lead to most valuable results? I do not lose sight of the fact that, for the tar distiller, the mechanical part of his business is of the greatest importance, such as the suitable arrangement of his plant, the economical carriage from one part of the works to the other of the bulky raw material and its products, &c.; but in order to derive full benefit from his operations he should be guided and assisted by experience derived from investigation.

(To be continued).

NOTICES OF BOOKS.

An Elementary Treatise on Practical Chemistry and Qualitative Inorganic Analysis. By FRANK CLOWES, B.Sc. Lond. London: J. and A. Churchill.

THIS book adds another to the many handbooks of qualitative analysis, the author's reason for writing it being the discovery that " the want of a sufficiently elementary and explanatory laboratory text-book was very widely felt." The student who could not find among the many manuals on analysis one well suited for his purpose would certainly be hard to please, but at the same time he would have little cause for dissatisfaction with Mr. Clowes's production, which is certainly all it professes to be.

The first section is devoted to the preparation and properties of a few of the principal useful gases, the distillation of water, and the preparation of nitric acid. In the following section, the author describes the preparation and use of apparatus, and gives a number of directions and hints which every beginner will appreciate. A separate chapter is devoted to manipulation.

There is little that is new in the analytical reactions or the methods of analysis, and many of the special and characteristic tests are omitted, unless utilised in the systematic methods. This is certainly a pity, for nothing is

of greater interest to the intelligent student than the trial of reactions out of the ordinary routine. The plumbic dioxide test for manganese, the potassium iodide reaction with bismuth, and the decolouration of permanganate by ferrous salts might advantageously be mentioned; but, on the other hand, the tests described are fully dwelt on, and any necessary precautions pointed out. But few of the organic acids are referred to, and no mention is made of alkaloids or of rare metals. In our opinion, no text-book of qualitative analysis can be considered complete that does not include, at least in a supplementary form, the reactions and methods of detecting some of the rarer metals. Book after book appears, and the authors systematically ignore metals like tungsten, molybdenum, titanium, uranium, cerium, and lithium, whose compounds are to be found in every laboratory, and some of which elements are met with in nature and commerce quite as frequently as the metals bismuth, cadmium, and cobalt, which are included in every scheme of analysis. But, in this respect, the book in question merely follows the general example, which, unfortunately, is that set in our Government college, where the course of instruction is deficient in these and other particulars. We do not know a better handbook, going over the usual restricted ground, than that under review.

The author avoids the eccentricities of notation and nomenclature which disfigure some works on analysis, as he rightly considers that it is undesirable that the student's practical text-book should tempt him to bestow valuable time in the laboratory upon the study of matters of mere theoretical importance.

An Introduction to Pharmaceutical and Medical Chemistry (Theoretical and Practical). By JOHN MUTER, M.A., F.C.S., &c. London: Simpkin and Marshall.

THIS work is one of a somewhat special character, as its title implies, but the author has succeeded in introducing a great deal of useful and new matter of interest to all chemists, while the remarkable clearness of type and absence of typographical errors make the reading of it a pleasure.

The author's arrangement of matter is certainly peculiar, and is not without some advantages, though we are disposed to doubt whether these are sufficient to justify the plan adopted. Thus, when describing the analytical reactions of the "simple basylous radicals," the author classes them as monads, dyads, &c., a course which necessarily results in the juxtaposition of potassium and silver, magnesium and mercury, iron and tin. We are glad to see hydrogenium in its proper place at the head of the monad metals.

The electro-negative arrangement of the various pharmaceutical preparations will, we fear, prove somewhat perplexing to the student, though the author is thoroughly consistent, and treats of all the principal sulphates in order, from hydrogen-sulphate to indigo-sulphate.

There is one objectionable item of nomenclature, against which we really must protest, and that is the abuse of the prefix "hydro." Thus we have potassium hydro-tartrate, disodium hydro-phosphate, ethyl hydro-sulphate, quinine hydro-sulphate. The term hydrosulphate is applied to acid sulphates instead of to unoxidised sulphur derivatives. By ethyl hydrosulphate, chemists generally understand mercaptan, whereas Dr. Muter uses the name to indicate ethyl-sulphuric acid. The confusion caused by such a change is well-known by the fact that the acid sulphate of quinine is called the hydrosulphate, while the hydrochlorate does not mean the acid chlorate, but the hydrochloride. Hydrochlorate and hydrosulphate are incompatible terms.

A considerable portion of the book is devoted to a very lucid exposition of chemical principles, followed by equally well written descriptions of various laboratory processes and manipulations.

The sections on alcohol derivatives and ammonia derivatives (alkaloids, &c.) are especially good, the author

being here thoroughly in his element; while the errors contained in a paragraph on the manufacture of iron and steel serve to show how difficult it is for a chemist to master the whole of his subject.

We have observed some rather serious errors in the analytical reactions and tables for systematic detection of metals. Thus, the solubility of calcium phosphate in ammonium citrate is ignored in a manner likely to bring the analyst to grief; again, we are directed to separate cadmium from copper by means of cyanide of potassium and hydrosulphuric acid, and to test for copper in the filtrate by acidifying with acetic acid and adding ferrocyanide, which is stated to give a chocolate-coloured precipitate. The author has here overlooked the fact that the addition of acetic acid would have thrown down cyanide and sulphide of copper. Such mistakes suggest the idea that the tables have not been in practical use. On page 153 we are told that all oxides dissolve in hydrochloric acid; while on page 220, the production of a white gelatinous precipitate, on adding excess of potassium hydrate to a solution of cadmium iodide, is said to indicate the absence of zinc!

But the errors are all of a minor kind, detracting but little from the actual value of the book, and readily corrected in a second edition, which the author promises to publish should the first find favour. This, we think, is certain to be the case, as the book is one of a very useful and original kind, and is brought up to the latest date, tests and processes published only a few months since being described in their proper places. A great many facts of pharmaceutical interest are mentioned which are not to be found in any other single work, and the author has certainly succeeded to a great extent in his original, but subsequently abandoned, plan of writing an "exhaustive treatise on chemistry, as applied to medicine and pharmacy."

Sewage no Value; the Sewage Difficulty Exploded. By E. MONSON, Assoc. Inst. C.E. London: E. and F. N. Spon.

IF the sewage difficulty is "exploded" in these pages, it is certainly not solved. There is little, if anything, here which is not perfectly familiar to all who have given their attention to the sewage question. There is, unfortunately, more than a little doubtful, if not utterly fallacious. The author admits that towns must not hope to sell their sewage, in accordance with certain theoretical valuations put forward to a great extent by the advocates of irrigation. But it by no means follows that sewage is of no value. Nor is it legitimate to say that the introduction of artificial manures has rendered the farmer independent of excremental matters. These artificial manures are made of bones, shoddy, leather, and certain minerals; but the supply of none of these is unlimited. If we go on, as we are doing, allowing the liquid and solid excrements of the population to be washed down to the sea, or if we treat them by any process which, like General Scott's cement scheme, withdraws them from organic circulation, the time must come when artificial manures will wax scarce. It is painful to find truths which Liebig has placed in so clear a light still ignored by one who comes forward to enlighten the public on a great social difficulty.

We find, further, the statement that, "if human excrement is removed by water, there is no way of purifying the water (so as to be?) fit for domestic use except by passing it through the soil." This is saying either too much or too little. We have met with no satisfactory evidence to show that the effluent from an irrigation farm, or an "intermittent downward filtration" bed, has any superiority over that obtainable by precipitation. But we should object to either the one or the other in our household. If the soil has such powers of disinfecting sewage as irrigationists asserts, how is it that the drainage of cesspools, graveyards, &c., can penetrate through the earth

unchanged, and poison wells at a considerable distance? We find, however, some admissions as to the effects of sewage irrigation, which, coming from one who is evidently no friend of chemical treatment, are doubly valuable. " Sewage, like water, retards the ripening of the fruit and grain, and develops the leaf." " Sewage cannot supersede manure, for it cakes the ground, seals up its pores, and prevents the air from getting at the roots of the crop." " Sewage cannot be utilised at a profit if it has to be pumped." " It has been found, says Burnell, at all times and in all climates, that irrigation develops the growth of the leaves at the expense of the fruit or grain."

If the first and last of the above-quoted passages express the truth, then to advocate irrigation is simply to agitate for the reduction of our native wheat supply. Is it wise to do this, if we remember that the countries from which we import grain are precisely those with which we are most likely to be engaged in hostilities?

" The land," we are told, " is the proper place for town refuse, and if sewage be disagreeable to the sense of smell it is not a nuisance injurious to health when upon the land." This is an oft repeated paradox. We are told that, if sewage runs in an open sewer, or is allowed to flow into rivers, the gases and vapours which rise from its surface are most prejudicial to health; yet at the same time we are expected to believe that, if such sewage is poured out over the surface of the earth, under circumstances calculated to promote evaporation, these very emanations cease to be injurious! The evidence obtained from India shows that irrigation, even with clean water, lowers the standard of health in the district. Precipitation, we must remember can be so conducted that nothing either offensive to the senses or injurious to health is given off at any stage of the process.

The author recommends that sewage intended for irrigation should be previously filtered. Now sewage is very difficult to filter, as has been lately proved on the large scale at Bradford, and as anyone may find who will try the experiment with a funnel, a filter-paper, and a pint of the liquid in question. Mr. Monson has himself admitted that it " cakes the ground and seals up its pores." Why this should be will be clear to every one on brief reflection. Sewage, however limpid, holds in suspension a large quantity of paper, finely comminuted, along with the fibres of linens, cottons, and woollens derived from the wash-tub, and in certain towns from manufacturing processes. This fibrous matter soon clogs up any filter, whether it be formed of paper, earth, or charcoal.

As a preparatory step to irrigation, Mr. Monson seems (p. 11) to recommend precipitation with lime. Now, all the lime processes—all modes of sewage treatment, that is, where lime is employed for any purpose save neutralising acids or acid salts—have this cardinal fault, that they expel any ammonia which may happen to be present. Hence, if it be true, as Mr. Monson expressly declares, that the most valuable part of sewage is ammonia, precipitation with lime is a capital mistake.

The pamphlet concludes with a section on artificial manures, from which we extract two passages:—" Carbon is the base of carbonic acid, and the most considerable element of the solid parts of minerals (!) and vegetables." " *Alumina* and the several varieties of clay may be regarded as silicates of alumina."

CORRESPONDENCE.

VALUATION OF PHOSPHATES.

To the Editor of the Chemical News.

SIR,—In reply to a question as to a statement by Dr. Voelcker that soluble phosphate can be bought at 3s. 6d. per unit, I will ask your correspondent to well consider the terms in which superphosphate of the best quality is supplied by the Lincolnshire Farmers' Association to its 750 members occupying 240,000 acres of land in the counties of Lincoln, Rutland, Nottingham, Huntingdon, York, Derby, Leicester. Northampton, Buckingham, Bedford, Cambridge, and Norfolk. The manure is guaranteed by Dr. Voelcker's analysis to contain 26 per cent of soluble phosphate, and is delivered *free* by rail to all its members at £3 16s. per ton. This is less than 3s. per unit; but if 15s. per ton is deducted for the value of the sulphate of lime, and 10s. per ton for carriage, it will make the actual cost of the soluble phosphate a fraction under *two shillings per unit.*

I shall be glad to supply any other information to your correspondent.—I am, &c.,

W. LITTLE.

The Hall, Heckington.

VALUATION OF PHOSPHATES.

To the Editor of the Chemical News.

SIR,—I shall be obliged if you will allow me to say a few words in reply to " A Gloucestershire Farmer." He appears by a clerical error to have written £7 10s. instead of £17 10s., but Dr. Anderson's old estimate of 6s. is decidedly above the present value of superphosphates. It may be, however, that this estimate is based on the actual percentage of monocalcic phosphate; while " soluble phosphate " technically means " tricalcic phosphate made soluble." Values have advanced considerably since the close of last season, and 3s. 6d. per unit is not now an unreasonable retail price for bone phosphates, but is rather too much even for high-class mineral supers. As an example I may mention that our retail price last season at our works was about 3s. 3d. per unit for a superphosphate made entirely of bone material, and which analysed upwards of 40 per cent soluble; and about 3s. 1d. per unit for mineral 36 to 38 per cent.—I am, &c.,

MANURE MANUFACTURER.

York, October 5, 1874.

DOUBTFUL MINERALS.

To the Editor of the Chemical News.

SIR,—I am afraid your correspondent T. A. R. must have been ransacking some ancient mineralogical works, for I cannot find more than 38 minerals out of the 150 he exterminates, in any good modern mineralogical books. In the best works I only found 14, and many of these are varieties of the same mineral. I will just notice a few minerals given by T. A. R.

Beaumontite.—Considered by G. Rose to be a distinct mineral; but Alger and Dana consider it to be Heulandite. It is without doubt Heulandite. It is extremely rare, and occurs in very small crystals having a quadratic appearance. In reality the crystals are monoclinic, showing the following forms :—

The basal terminal plane, OP
The Clinopinacoid, $(\infty P \infty)$
The orthopinacoid, $\infty P \infty$ ⎫
The positive ortho-dome, $P \infty$ ⎬ in equilibrium.
The positive hemipyramid, 2P ⎭

This form looks very like the combination of the prism of the first order (∞P) with the pyramid of the first (P) in the quadratic system.

Belonite.—Is a genuine mineral, crystallising in the rhombic system, in long needles. It is now called Aikenite. Its composition is as follows.

Bi	34·45
Pb	36·05
Cu	10·59
S	16·61
	100·00

Cyanolite.—Is simply Okenite.

Dopplerite.—Is a variety of brown coal. Is rightly named.

Herrerite.—Should be called *impure* Smithsonite (zinc carbonate with malachite as an impurity).

Idryl—Is now called Idrialine or Idrialite. Is a carbonaceous substance accompanying cinnabar. Is rightly named Idrialite.

Kalkoolborthite.—Exists at the present moment as Volborthite. Crystallises in the hexagonal system. Is a vanadate of copper with calcium vanadate and water.

Dumasite.—Is chlorite.

Polyhalite.—Is rightly named.

Pyromeline.—Is now called Morenosite. Is a genuine mineral. Is sulphate of nickel with water.

Zaratite.—Is now called Zaratite. Was formerly called "Emerald Nickel." Is a genuine mineral having the following composition.

NiO	.. .. ..	58·81
CO₂	˙	11·69
H₂O	.. ˙.. ..	29·50
		100·00

Mineralogy has made rapid strides within the last five years, so that a book dating 1868 is already far behind, and almost useless. T. A. R. has, however, done good service in bringing before the notice of mineralogists the absurd names which are still to be found in some mineralogical works.—I am &c.

CHARLES A. BURGHARDT, Ph.D.,
Lecturer in Mineralogy.

The Owens College,
Manchester, Oct. 6, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 8, August 24, 1874.

Ninth Note on Guano.—M. E. Chevreul.—The author announces the discovery in guano of a compound of a double chloride of ammonium and sodium, forming cubic and octahedral crystals. In his final reflections he urges that the value of a manure cannot be ascertained from its mere ultimate analysis—its proximate composition requiring also to be taken into consideration.

Passivity of Iron.—M. A. Renard.—Iron wires exposed for ten minutes to the action of nitrous vapours are not attacked if subsequently plunged into nitric acid of 30° to 40° B. Into a glass containing nitric acid of 30° to 40° B. was plunged an iron wire, one part of which remained outside the liquid, and the acid was stirred to lessen the intensity of the action. The wire was then withdrawn and re-inserted. After a few immersions the part withdrawn became passive. To obtain this result easily the wire ought to be quickly re-inserted at the moment when a very transient whitish tint appears on its surface. At the very instant when the wire becomes passive under these circumstances, there is all around it a slight gaseous covering, which may be very distinctly perceived on moving it gently in the liquid. To render an iron wire passive it is sufficient to plunge the third or fourth part of its length into mono-hydrated acid for about ten minutes, to place it in a test-glass, the bottom of which contains acid of from 30° to 40° B., and to fill up the glass with the same acid. The part of the iron which has not been immersed in the mono-hydrated acid is not

attacked, and the whole wire becomes passive. To succeed with this experiment it is well to flatten with a file the end of the wire which is not to be plunged into the mono-hydrated acid. This precaution, needless with acids of 37° to 40° B., is necessary with less concentrated acids, otherwise the iron is attacked when the acid reaches this point. An iron wire plunged into common nitric acid of 30° to 40° B., after having been placed in acid of 47° B., is not attacked even if briskly stirred. It is passive, but a similar state is only permanent with acids of 37° to 40° B. Passive iron, preserved in acids of ·30° to 36° B., is attacked after some days. Acids below 30° B. attack passive iron after a few hours.

Direct Combination of Chromic Acid with Wool and Silk, and its Applications in Dyeing, and in the Analysis of Wines.—M. E. Jacquemin.—Chromic acid has the power of combining directly with wool and silk, forming with them a yellow compound which resists washing and soaping. The author passes white wool into a bath at about 60° C., containing carbonate of soda to about the fifth of the weight of the wool to be dyed. Then, after washing, he introduces them into a luke-warm bath containing per kilo. of wool—

Bichromate of potassa	60 grms.
Sulphuric acid at 66° B.	60 ,,
Water	40 to 50 litres.

In a few minutes, at 30° C., the wools take a fine straw yellow. For darker shades they are worked for twenty minutes at a temperature which need not rise above 60° C., and then washed in abundance of water. Cotton is not dyed under the same conditions. This reaction may be used for distinguishing animal from vegetable fibres. Chromic acid when combined with wool preserves some of its characteristic properties. On treatment with cold subacetate of lead it combines with oxide of lead without leaving the animal fibre, and forming a decided chrome yellow, the tone of which differs from that produced by the acid alone. Sulphurous acid reduces it to the state of chromic oxide, which remains combined with the wool. Chromic wool has no action upon a cochineal bath. It takes up the aniline colours without sensibly modifying them, the darker shades being merely somewhat flattened. If chromic wool is boiled in fustic liquor it takes solid reseda, and with madder a catechu garnet. Orchil dyes chromic wool, but the colour is rather flat. Peachwood gives a deep wine-lees shade. Logwood gives a brown; logwood and peachwood mixed produce iron-greys, bordering upon black, and, with the addition of fustet, a good black. Chromic wool immersed in a genuine wine, no matter of what growth, and boiled for a long time, takes a characteristic light brown. Cochineal, which is sometimes used to colour sophisticated wines, has no action. The author has found that certain red caramels sold at Paris for the purpose of colouring wines owe their tinctorial power to derivatives of aniline.

Ureides of Pyruvic Acid, and on its Bromated Derivatives.—M. E. Grimaux.—This paper is not adapted for abstraction.

Analyses of Specimens of Veal, Mutton, and Pork, as Sold in the Markets of Paris in 1873 and 1874.—Ch. Mène.—A tabular view of the results of the ultimate analysis of the samples.

Action of the Sulphuretted Hydrogen of the Springs of Luchon upon Granite.—M. F. Garrigou.—The sulphuretted hydrogen liberated from the waters, and meeting with rocks, more or less permeable to air, is decomposed, furnishing different products according to circumstances, sometimes sulphuric acid and water, and sometimes free sulphur. The former change ensues where the air has free access. The sulphuric acid attacks the rocks, and forms sulphates at the expense of their soluble constituents. The felspar of the granites contains silicates of lime, soda, potash, and lithia. Cæsium and rubidium are also present.

No. 9, August 31, 1874.

Remarks on Certain Recent Researches on the Explosive Force of Gunpowder.—MM. Roux and Sarrau.—The authors point out the general agreement of the results obtained by Messrs. Noble and Abel with their own.

New Form of Prism for Direct-Vision Spectroscopes.—J. G. Hofmann.—In the author's earlier direct-vision spectroscopes the system of prisms was 10 centimetres in length. In the new pattern it is reduced to 8. The field is naturally larger, and the rays pass along the axis of the system.

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Liebig's Annalen der Chemie und Pharmacie.
July 15, 1874.

Researches Carried on in the Laboratory of Beilstein, at St. Petersburg.—These include papers on certain ethereal oils, by Kurbatow (frankincense, and oil of calamus); on sulpho-propionic acid; on ethyl-sulphonic ether; and on isomeric sulpho-cinnamic acids.

Formation and Decomposition of Metallic Sulphides.—K. Heumann.—The author examines the reaction of copper and the polysulphides of ammonium; of copper and monosulphide of ammonium; of cupric oxide and monosulphide of ammonium; of copper and ammoniacal solutions of sulphides of arsenic and antimony; the changes of cinnabar on exposure to light; and the desulphurisation of silver in the moist way.

Contributions to the Knowledge of the Ammonia Derivatives of Benzol.—H. Salkowski.—This paper contains an account of dinitro-salicylic-ethyl-methyl ether $C_6H_2(NO_2)_2OC_2H_5CO_2CH_3$; dinitro-anthranilic acid, its ammonia salt, and its methylic and ethylic ether; dinitro-salicylic-dimethyl-ether, its decomposition by ammonia; the methyl-ethyl and diethyl ethers of the same acid; nitro-anisic acid, and its decomposition by ammonia; nitro-paramido-benzoic acid, and its potash, ammonia, and baryta salts; its decomposition by alkalies, and its reduction; ortho-phenylen-diamin, and its combinations with acids; the conversion of nitro-paramido-benzoic acid into nitro-benzoic acid; nitro-para-diazo-benzoic acid; the action of ammonia upon anisic acid, upon methoxy-benzoic acid, and upon methyl-salicylic acid.

Investigations into the Volume-Constitution of Solid Bodies.—H. Schröder.—This paper treats on the isosterism of NH_3 and NH_4, of CrO_3 and CrO_4, and of WO_3 and WO_4.

On Cinchonin.—H. Weidel.—An extensive essay, not adapted for abstraction.

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Repertorium für Experimental Physik,
Band x., heft 2 and 3.

Preparation of Plateau's Glycerin-Liquid, and on its Application in the Study of the Coloured Rings Produced by their Laminæ.—A. Terquem.—Some years ago Plateau described the composition and preparation of the glycerin liquid which he employed in producing the equilibrium forms shown by the surfaces of liquids withdrawn from the influence of gravitation. His method of preparation being complicated, and not always successful, the author has endeavoured to remove these objections, and produce a glycerin-fluid of constant composition, whatever may be the nature of the soap employed. He avails himself of the circumstance that the oleates are more readily soluble in alcohol than the stearates. He takes Marseilles soap, and reduces it to shavings with a plane in order to dry it the better. If these shavings are exposed to the sun in summer, or laid on a stove in winter, they are perfectly dry in a few hours. They are then put in a bottle with alcohol of 80°. The specific gravity of such alcohol is 0·865, and, if saturated with soap at the temperature of 15° C., it marks 74 on the centigrade alcoholometer. Its specific gravity is then 0·880, and 10 c.c. contain 0·742 grm. of soap. The solution of the soap must be effected in the cold. At higher temperatures much more soap is dissolved, and the result is, on cooling, a solid mass. In the meantime a mixture of glycerin and water is prepared, in such proportions as to mark 17·1° B., = sp. gr. 1·35 at 20° C. This represents a mixture of equal volumes of water and of the most concentrated glycerin. The bottle containing the mixture of glycerin and water may be advantageously heated with boiling water to prevent the development of confervæ. To prepare the final mixture take 100 c.c. of the diluted glycerin, and add 25 c.c. of the alcoholic soap solution. The liquid is liable to become turbid if the glycerin contains sulphate of lime. In order to expel the alcohol, the mixture is then brought to a boil until its point of ebullition rises to 100° C. It is then allowed to cool, poured into a graduated glass, and made up to 100 c.c. with distilled water. It is then repeatedly filtered to remove any oleate of lime which may have been formed. The filtration is tedious, and may require to be several times repeated. The uses of this liquid, in the performance of Plateau's experiments, are next described. This portion of the paper is useless without the accompanying engravings.

Apparatus to Demonstrate the Propagation of Sound in Gases.—A. Terquem.—Unintelligible without the illustration.

A Variation Barometer.—F. Kohlrausch.—The author describes and figures the method of preparing a barometer combining unlimited sensitiveness with total freedom from friction.

Approximate Conditions of Reflection and Refraction for the Main Section of Moving Media.—E. Ketteler.—Not adapted for abstraction.

Specific Law of so-called Anomalous Dispersion.—E. Ketteler.

Specific Heat of Carbon.—Carl Puschl.—The diamond is more abundantly permeated by invisible heat rays the lower the temperature of their source. In other words, its opacity for invisible heat rises with the temperature of the source.

Simultaneous Movement of Light in Moving Media.—Carl Puschl.—Not adapted for abstraction.

The Air Thermometer.—P. Jolly.—This paper, again, is useless unless accompanied by an engraving.

Reduction of the Degrees of Intensity Given by the Anemometers used in Switzerland and Baden to the Actual Velocity of the Wind.—Dr. G. Lübeck. This paper also requires diagrams.

Determination of the Freezing-Point for Delicate Thermometers.—Dr. G. Krebs.—Schultz, in his treatise on the freezing-point of the water of gaseous solutions and the regelation of ice, shows that the freezing-point of water is lowered by dissolving gases, the change being nearly proportional to the amount of gas dissolved. That water holding solids in solution freezes at a lower point is well known. Thomson and Clausius have shown from the principles of the mechanical theory of heat that the freezing-point of water falls 0·007° C. for every additional atmosphere of pressure. To determine the true freezing-point, take a glass tube closed at one end, 20 centimetres long and 2 wide, fill it almost full with sulphuric acid, and heat. Then pour out the acid, and rinse repeatedly with pure distilled water. The tube is then two-thirds filled with distilled water, which has been boiled for some time in a clean beaker, and a small quantity of filtered oil of turpentine (about 1 centimetre in depth) is poured upon the water. The tube is then carefully heated in the oil-bath, without allowing the temperature to rise to the boiling-point lest an explosion should ensue. The object of the heating is to remove any air bubbles which may adhere to the side of the glass, or may remain between the turpen-

tine and the water. When the water has been thus exposed for a considerable time to a temperature very near to the boiling-point, the tube is taken out of the oil-bath, cooled in cold water, and then placed in a freezing mixture (water and nitrate of ammonia). After a few minutes the water is cold, and in most cases a portion of it freezes at once if a thermometer is inserted, and moved up and down. If this does not take place the tube must be returned to the freezing mixture, and cooled more strongly. The thermometer may be previously placed in an empty test-tube, which is then plunged in the freezing mixture. It is very important that the thermometer should be cooled down close to the freezing-point before being introduced into the water. The best thermometers when tested in this manner show a freezing-point too high by about 0·1° C.

Soldering Platinised Glass.—Dr.W.C. Röntgen.—The platinised glass is well cleaned, slightly heated to prevent the glass from flying, coated with the flux (chloride of zinc), and tinned with the soldering iron. Care must be taken not to bring this tool too much in contact with the platinum coating, as the latter otherwise becomes too thoroughly alloyed with the zinc, and disappears from the glass. When the glass is tinned over it is ready to be soldered to any metal.

A Modification of the so-called Poison Syphon.—A. Weinhold.—Gawalowski describes a syphon for volatile dangerous liquids without exposing the mouth of the operator. The author describes an improvement, which, however, cannot be understood without the accompanying figures.

Conversion of Common into Amorphous Phosphorus.—Von Schrötter.—A description of several apparatus for effecting this conversion. The change is produced by electricity, and not by heat or light accompanying the current.

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Moniteur Scientifique, du Dr. Quesneville, August, 1874.

Theory of the Formation of Nitre in Peru.—Antony Guyard.—The nitre districts of Peru form a plateau of a mean elevation of 3000 feet, 15 to 20 leagues broad, and several hundred leagues in breadth. The author supposes that there has been an epoch when nitrogen compounds were disengaged from the volcanoes, ust as there were sulphuric, hydrochloric, and boracic epochs. The alkali is derived from the decomposing porphyritic mountains, which have also given rise to the beds of kaolin and other clays. In general, the saltpetre exists in the form of saccharoid barks, formed principally of nitrate of soda and chloride of sodium, mixed with nitrate and iodate of potash, chlorides of magnesium, aluminium, and calcium, sulphates of lime, magnesia, and alumina. The earthquakes of these regions he considers to be subterranean electric storms. The author opposes the view that the nitre beds are derived from decomposed guano, and the iodates from sea-weeds. He has already shown that the colouring matters of the nitre beds are not of organic origin, the yellow being chromic acid and the violet manganic.

On Lupuline.—Dr. Griessmayer.—An interesting paper, but unsuited for abstraction.

Industrial Preparation of Chloride of Lime.—A controversy between M. Gœpner and MM. Richter and Junker.

Manufacture of Artificial Butter in America.—An account of various processes—now sufficiently notorious—for making butter from the fat of cattle.

Chemical Products at the Vienna Exhibition.—M. E. Kopp.

Pyrogallol in Presence of Salts of Iron.—M. E. Jacquemin.—In presence of organic ferric salts pyrogallol does not behave as with mineral ferric salts. It produces

a blue soluble in water, and permanent for some days. Ferric sulphate and perchloride, if treated with a slight excess of an organic salt of an alkali or an alkaline earth, acquires also the property of yielding a permanent blue with pyrogallol. The action of ammonia upon the pyrogallo ferric chloride is so sensitive that 1 grm. of perchloride of iron is enough to colour 2 hectolitres of water a reddish purple. Hence every substance which can change the reddish brown ferric pyrogallol to a blue, a violet, or a reddish purple may be ranked among the alkalies or alkaloids. Hence we have a simple means for distinguishing alkaloids from glucosides. To prepare the reagent it is necessary to add very little ferric chloride to the pyrogallol, since a slight excess of the latter is not hurtful. An alcoholic solution may be used if the substance be insoluble in water. The alkaloid, even if solid, turns blue in contact with the pyrogallo ferric chloride, whilst glucosides produce no change of shade.

Albumenoid Bodies.—M. A. Commaille.—The substance of this paper has been already noticed in the CHEMICAL NEWS.

Part Played by Salts in the Action of Potable Waters upon Lead.—M. Fordos.—The author finds that sulphate of soda, chloride of sodium, chloride of ammonium, nitrate of potash, nitrate of ammonia, sulphate of lime, and sulphate of magnesia do not hinder the joint action of water and atmospheric carbonic acid upon metallic lead, and that traces of the lead remain in solution.

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Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 9, September, 1874.

There is no chemical or physical matter in this number. The paper on the phosphatic deposits of Calvados treats merely of the extent and distribution of the phosphate beds, without any reference to chemical or mineralogical considerations.

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Reimann's Farber Zeitung, No. 35, 1874.

This number contains receipts for a brown and a dark nacarat on cotton yarn; a description of a new wringing machine, and of a rinsing machine; a continuation of the directions for dyeing with aniline colours; a test for ultramarines as regards their value for blueing white grounds, the sample being preferred which, when diffused in water, attaches itself best to a swatch of white calico hung up in the liquid.

Methyl violet has been recommended as an indication for acids in place of litmus; it is not, however, affected by acetic acid.

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Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, No. 17, 1874.

Determination of Lead in Ores.—Lowe, having observed that the aqueous solution of hyposulphite of soda is capable of dissolving sulphate of lead, proposes to utilise this reaction for removing this salt from stony residual matter. Such residues, perfectly washed and separated from the filter, is stirred up in a suitable vessel with a cold concentrated solution of hyposulphite of soda. It is allowed to settle for some time, washed by decantation, and the residue stirred up afresh with a further quantity of the same solution. This operation having been repeated two or three times, the solutions are mixed together, and the lead is separated by means of sulphuretted hydrogen or hydrosulphate of ammonia. The sulphide of lead thus obtained is further treated in the usual manner.

Poison of Nettles.—M. C. Naudin maintains that after a violent wind the sting of the nettle is deprived of its virulence.

Tome xxxv., No. 1, September 3, 1874.

Lippmann's Electro-Capillary Motor.—This paper would be unintelligible without the accompanying illustration.

Photography at the Bottom of the Sea.—Dr. Neumayer has recently presented to the Geographical Society of Berlin a photographic apparatus destined to determine the temperature and the currents at great depths in the ocean.

Atmospheric Corpuscules.—M. Lamey.—The author holds that the " luminous particles," which M. F. Anderson describes as seen in a pure atmosphere near the sun, have no objective existence, and must be regarded as a physiological phenomenon.

No. 2, September 10, 1874.

Means of Banishing Weevils from Granaries.—M. A. Flament.—It has been observed that a few bundles of raw hemp completely expels these destructive insects from a granary.

New Eudiometer.—M. A. Dupré.—This paper should have been accompanied by a diagram.

Bulletin de la Societe Chimique de Paris, tome xxii., No. 1, July 5, 1874.

Action of Ammonia upon Phenyl and Cresyl Chloracetamid.—M. D. Tommasi.—This paper has been already noticed.

On Fluoxyboric Acid.—M. A. Basarow.—The author concludes that fluoxyboric acid is not a homogeneous body, but merely a solution of boracic acid in hydrofluoboric acid.

Action of Bisulphide of Carbon on Benzoin, the Balsams, and the Resins.—M. P. Guichard.—A pharmaceutical paper on the solubility of drugs.

Iodide of Ethyliden.—M. G. Gustawson.—The iodide of ethyliden yields with alcoholic potash the same product as the iodide of ethylen, *i.e.*, iodide of vinyl. These results do not agree with those of Semenoff, who obtained a body isomeric, but not identical with, iodide of vinyl.

Determination of a Mixture of Sulphides, of Sulphuretted Hydrogen, and of the Hyposulphites.—M. Schlagdenhauffen.—A valuable paper; too long for insertion.

Identity of Bromoxaform and of Pentabromated Aceton.—M. E. Grimaux.—This paper has been already noticed.

On Soluble Starch.—M. Musculus.—Already noticed.

Modification of the Blowpipe.—M. A. Dupré.—An improvement on Luca's blowpipe. Its construction, in the absence of an illustration, is difficult to understand.

Facts Observed in the Study of Sugar.—E. J. Maumené.—A reconstruction of the tables drawn up for ascertaining the value of saccharine solutions by means of their sp. gr.

Process for Determining Tannin in Wines, and on the Experimental Stations in Italy.—E. J. Maumené. —A known volume of the wine is measured out, and alcohol is added in moderate quantity. An excess of solution of caustic baryta is added, then a little sal-ammoniac. The mixture is heated for some minutes, cooled, and the precipitate washed first with concentrated alcohol and then with cold water. The tannic precipitate is then treated with dilute boiling sulphuric acid, and the tannin in the solution is determined by permanganate of potash.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

A new medicinal compound, and plasters made therewith. John McIntyre Smith, New York. (A communication from Dr. Paul Edmond Audouit, surgeon, Havre, France.) January 23, 1874.—No. 297.

One of the most important uses of the compound and of the plasters is to prevent sea-sickness. The following is a description of what is considered the best means of carrying out the invention:—Take of what is known as diachylon (in French, *emplaytre de diachylon*), sometimes called court-plaster (an oxide of lead and oil), 2 grms. With this thoroughly mix 2 grms. of theriac, or Venice treacle (in French, *theriaque*), and 1 grm. of extract of belladonna (in French, *extrait belladonne*), and preserve the compound in a tight stoppered vessel. To use the compound as a preventive or cure for sea-sickness, spread it to about the thickness of an ordinary adhesive plaster on a small oval piece of kid or other soft leather. One of these plasters being slightly warmed is applied and caused to stick on the pit of the stomach. Thin muslin paper, thin vegetable parchment, and various other substances may be used with success, instead of leather, as a foundation for the plaster.

An improved composition or material to be used in lieu of coal for fuel. Edwin Lowe, coal dealer, Birmingham, Warwick. January 26, 1874.—No. 326. I propose to collect the dry sewage out of the streets or ashpits, or other equivalent accumulations of dry matter, and having driven out any remaining moisture therein, to grind it in a mill or by other suitable means to a proper degree of fineness. I then mix with the said dry matter a proper proportion of (1) gas-tar, (2) charcoal, (3) coal slack, (4) clay washings; and the whole being well mixed together, is then compressed into moulds of a suitable size, and then dried and allowed to acquire a hard consistency, when it is ready for use as fuel. The improved fuel as thus produced can be used for any purpose where fuel is required. Thus, it may be employed either for blast-furnaces or for domestic use, being equally serviceable in either case, but the relative proportions of the ingredients to be mixed with the dry sewage matter is altered as required to suit the draught or fire where the material is destined to be employed.

Improvements in the manufacture of sulphuric acid. Henry Glover, Bow, Middlesex. January 27, 1874.—No. 346. This invention relates to improvements in effecting the concentration of weak sulphuric acid, such, for example, as that known as chamber acid or brown acid, so as to produce or manufacture sulphuric acid of commerce; and consists in effecting such concentration by means of highly-heated air or gases which are not acted upon by sulphuric acid; and causing such heated air or gases to be forced through, and be brought in contact with, the acid to be concentrated by preference in the form of finely-divided streams or currents.

Improvements in the manufacture of bicarbonate of soda. James Richards, chemist, Clifton Lodge, near Preston. January 29, 1874.—No. 376. My invention consists in treating bicarbonate of soda by a dilute solution of caustic ammonia, which decomposes the bicarbonate of ammonia, thus forming carbonate of ammonia, which is easily removed by washing.

Improvements in the manufacture of alloys of iron. Alexander Browne, of the firm of Browne and Co., patent agents, Southampton Buildings, Holborn, Middlesex. (A communication from the Foundries and Forges Company, of Terre Noire, La Voulte, and Bessèges, France.) February 2, 1874.—No. 422. The features of novelty of this invention consist of improvements in the manufacture and treatment of alloys of iron with manganese, tungsten, titanium, silicium, and other like substances: and is comprised under the following heads:—First. In methods of preliminary treatment of the materials used by combining them previous to the operation of smelting. Second. In the adoption of specific proportions of materials with a view to the production of definite alloy. Third. In collecting the alloy thus produced in the most economical manner; and this is accomplished by a double process, that is to say—(1) Rendering the slag or cinder perfectly fluid; (2) by subsequent additions of metals or alloys to cause a union of the scattered portions into one mass. To fully understand the whole course of the operation it is necessary to refer to the Specification.

Improvements in the manufacture of gum and gum-like substances from linseed oil and other similar oils. William Robert Lake, of the firm of Haseltine, Lake, and Co., patent agents, Southampton Buildings, London. (A communication from Donald D. Cattanach, Providence, Rhode Island, U.S.A.) February 2, 1874.—No. 423. This invention consists in the manufacture of a gum or a gum-like substance from linseed oil or kindred oils by a process of treatment involving mainly the exposure of the oil to air and light, accompanied by frequent and continued agitation or stirring of the oil during such exposure, with or without a preliminary purification of the oil so treated.

The incineration of mixed vegetable substances from wools or woollen fabrics by the application and manufacture of chloride or chlorate salts, preferably of zinc, magnesium, and aluminium, applicable to unbleached and dyed or coloured materials.—Edward Griffith Brewer, Chancery Lane, Middlesex. (A communication from Romain Joly, Caudebec-lès-Elbeuf, France.) February 3, 1874.—No. 433. This invention consists in the incineration of vegetable matters contained in wool or woollen fabrics by means of chlorides or chlorates of zinc, magnesium, and aluminium, and in the manufacture of the latter product.

TO CORRESPONDENTS.

ERRATA.—In No. 767, p. 57, col. 2, line 24 from top, for 5 hours *read* 2 hours; line 25, *for* 10 hours *read* 4 hours.

W. C. P.—No.

J. G. Laurie.—Perhaps Johnson and Matthey, of Hatton Garden, could supply it; we do not know.

J. H. J. R.—Order of any foreign bookseller.

THE CHEMICAL NEWS.

VOL. XXX. No. 778.

ON COLOPHTHALINE AND COLOPH-ALUMINA.
By PAUL CURIE.

UNDER the above names I purpose to describe a solid hydrocarbon and a new organic base prepared from common resin (colophony). Among the last products of the destructive distillation of resin there is found, in comparatively small quantities, a solid hydrocarbon which has been generally spoken of as naphthalin, and has therefore not attracted to any considerable degree the attention of chemists. This is *Colophthaline.*

When, instead of submitting resin to a slow distillation, such as is practised in the manufacture of "resin oils," it is decomposed rapidly at a red heat, the liquid products, or "oils," are reduced to a minimum, gases are produced in large quantities, and the proportion of colophthaline is greatly increased; but this solid hydrocarbon can be obtained more readily, and in still larger proportions, by the following process:—

100 parts of resin and 50 parts of sulphur are heated together in a retort at a temperature which can gradually be raised to about 200° C. The reaction begins at about 150° C.; sulphuretted hydrogen is evolved in abundance, and also a small quantity of water, which distils, and represents the loss, under that shape, of the oxygen of the resin, $C_{20}H_{16}O_2$. When the temperature has reached 200°, and no more HS is disengaged, the substance in the retort has the appearance and composition of a resin in which O is replaced by S. No further reaction takes place until the heat be carried to about 400° C.; a fresh quantity of HS is then produced, and at the same time the hydrocarbon colophthaline distils, together with a small quantity of a liquid of equally high boiling-point. The quantity of colophthaline thus obtained reaches, after purification, about 30 per cent in weight of the resin employed. The same results are obtained by the action of sulphur on terebene, colophene, or on common resin oil, instead of colophony itself. This process has enabled me to prepare large quantities of colophthaline with the greatest facility and in a form admitting of easy purification. I will now proceed to describe some of the principal properties of this hydrocarbon, which, as will be seen, has but a very distant resemblance to naphthaline, and is the source of at least one very remarkable body.

Colophthaline is easily soluble at the ordinary temperature in benzol, naphtha, spirits of turpentine, carbon bisulphide, and ether; it is dissolved by alcohol and glacial acetic acid at their boiling-point only, and is deposited again on cooling. The liquid products with which colophthaline is mixed being much more easily soluble in alcohol, this substance can by this means be completely freed from them. Thus purified, colophthaline is a flocculent white body, possessing a slight balsamic odour. Its melting-point is at 70° C., and, when melted, its colour becomes brown; it boils at about 400° C. It is composed of—

Carbon	93
Hydrogen	7
	100

which numbers correspond to the formula $C_{22}H_{10}$.

Oxidising agents, chlorine, and nitric acid, attack colophthaline with the greatest facility, and form the following compounds:—

Oxicolophthaline, a fine orange-yellow crystalline substance, slightly soluble in cold alcohol; completely soluble in boiling alcohol, ether, bisulphide of carbon, &c.;

insoluble in alkaline solutions; not volatile; decomposable by heat; prepared by dissolving colophthaline in boiling glacial acetic acid, and adding thereto about three times its weight of chromic acid dissolved in acetic acid, or bichromate of potassa in sulphuric acid. When the reaction is terminated, the oxicolophthaline is in solution, but on cooling down the liquid, or adding thereto 2 volumes of water, this substance separates; it must then be collected on a filter, washed, and purified by crystallisation from alcohol. Composition, $C_{22}H_8O_2$.

Chloro-Colophthaline, $C_{22}H_8Cl_2$; this is a viscous greyish yellow body, obtained by gently warming colophthaline with chlorine, or with chlorate of potassa and hydrochloric acid. When prepared from dry chlorine, the reaction takes place with great energy, brilliant flashes of light being evolved, and the product partly decomposed.

Nitro-Colophthaline is prepared by heating the hydrocarbon with nitric acid until it is entirely dissolved therein. On cooling, the nitro-colophthaline precipitates. It is an ochre-coloured, resinous, non-volatile, and uncrystallisable substance; slightly soluble in dilute acids; completely so in concentrated acids, and in ether, benzol, bisulphide of carbon, &c.; it melts at 100° C., but a higher temperature decomposes it. Caustic alkalies dissolve nitro-colophthaline; on boiling the solution, it loses its nitrogen in the shape of ammonia, and the liquid, which is then of a yellowish brown colour, contains, in combination with the alkaline base, a substance which can be precipitated in brown flocculae by the addition of an acid. This I shall call *Coloph-Ulmic Acid*, on account of its properties closely resembling those of ulmic acid.

Now the substances above described as oxi-, chloro-, or nitro-colophthaline, and coloph-ulmic acid, all undergo a most remarkable reaction when fused with hydrate of potassium. They are transformed into a white amorphous body of decided basic properties, having so nearly exactly the appearance of alumina that it might be easily mistaken for that metallic oxide. For this reason I claim for this new substance the name of *Coloph-Alumina*, and I will now proceed to enumerate some of its extraordinary characteristics.

Coloph-Alumina having been prepared in the manner above described, the fused alkaline mass is dissolved in dilute hydrochloric acid, in which solution ammonia forms a voluminous precipitate of hydrate of coloph-alumina; this white gelatinous precipitate being washed, and left to dry spontaneously, loses the greater part of its water, and shrinks gradually into a compact, hard, stony-looking mass, which still retains 1 equivalent of water, and only loses it at a high temperature. Coloph-alumina is insoluble in all neutral liquids—water, spirits, ether, &c.; it is infusible and non-volatile; it resists the action of all oxidising agents, though at a high temperature, and *is not decomposed even at* 1000° C. by chlorate or nitrate of potassa! Owing to the difficulty of decomposing coloph-alumina, it has been found impracticable to effect its analysis by any direct method; its chemical composition, however, as deduced from the mode of its formation, appears to be represented by $C_{20}H_6O_4$.

The basic properties of coloph-alumina are not very energetic. Nevertheless hydrochloric, nitric, acetic, and oxalic acids dissolve the base with ease, but the salts thus formed have not been obtained otherwise than in solutions, as by concentrating the liquor the base and the acid are too easily dissociated.

Concentrated sulphuric acid does not merely *dissolve* coloph-alumina; heated to about 200° C., it substitutes SO_3 to H, and forms a compound which is amorphous and nearly insoluble in water—*Sulpho-Coloph-Alumina*, probably $C_{23}H_4(SO_3)_2O_42(HO)$; a red heat merely regenerates coloph-alumina from this.

Chloro-Coloph-Alumina is also a substitution compound obtained by heating coloph-alumina to redness in a porcelain tube through which passes a slow current of dry chlorine; HCl is disengaged, and the resulting product, $C_{20}H_4Cl_2O_4$, is a white, non-volatile, insoluble powder,

fusible at a very high temperature. Sulphur has no action whatever on coloph-alumina, but a sulphide can be prepared by the same process as that used for the production of sulphide of aluminium, viz., by sending vapours of bisulphide of carbon over red-hot coloph-alumina ; this sulphide is insoluble in water, and attacked by acids with disengagement of HS.

Coloph-alumina, as I have already said, resists the direct action of oxidisers, but a combination with oxygen is obtained by acting on the substitution compounds, sulpho- or chloro-coloph-alumina ; these, being fused with caustic potassa in excess, exchange their SO_3 or Cl for O. The new body thus formed is an acid—*Coloph-Aluminic Acid*—which remains in combination with the alkali in excess, according to the reaction—

$$C_{20}H_4Cl_2O_4 + 4KO.HO = 2(KCl) + 2HO + 2(KO)C_{20}H_4O_6.$$
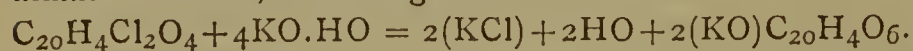
The coloph-aluminate of potassa while fused is of a fine "turquoise"-blue colour. Unfortunately coloph-aluminic acid cannot be obtained separated from its alkaline combination ; the mere action of water destroys it, regenerating coloph-alumina with loss of oxygen.

Such are the principal facts relating to these new bodies on which I believe it is of some importance to call the attention of chemists in general. I have only indicated here one source of production of coloph-alumina, but, from certain recent experiments, I have reasons to believe that it can be obtained from various other substances, and by other means than those here mentioned. At all events I have already ascertained that coloph-alumina is invariably the ultimate result of all energetic oxidisations of common resin, and perhaps of most kinds of resins. It might therefore frequently exist ready formed in the organs of certain plants, and be mistaken for alumina in analysing their ashes ; such an error would no doubt inevitably occur in presence of a hitherto-unknown organic base having the extraordinary property of being undecomposable by a red heat.

ON THE TESTING OF CRUDE ANTHRACEN
By R. LUCAS.

As " crude anthracen " is at present sold by two different tests, the " bisulphide of carbon " test and the " anthraquinon test," it may be interesting for some of your readers to have comparative results of both tests.

The following tests were made of twenty samples of crude anthracen from eight different English manufacturers :—

Percentage of Anthracen.

No. of Sample.	By Bisulphide Test.	By Anthra-quinon Test.	Difference.
1.	9·20	11·90	+ 2·70
2.	16·00	16·40	+ 0·40
3.	24·50	26·10	+ 1·60
4.	34·00	27·80	− 6·20
5.	35·00	28·20	6·80
6.	38·00	29·67	8·33
7.	38·00	33·38	4·62
8.	40·50	38·00	2·50
9.	43·00	33·80	9·20
10.	49·00	34·24	14·76
11.	57·40	44·51	12·89
12.	58·00	41·50	16·50
13.	59·00	44·51	14·49
14.	59·50	39·37	20·13
15.	60·00	37·66	22·34
16.	60·00	42·80	17·20
17.	64·12	48·79	15·33
18.	65·00	47·08	17·92
19.	67·00	46·22	20·78
20.	73·00	49·22	23·78

consider the anthraquinon test the only reliable test or the valuation of anthracen, because the product

obtained by the bisulphide of carbon test is not " pure anthracen," but only a mixture containing variable quantities of pure anthracen. A portion of the anthracen contained in the crude sample is dissolved by the bisulphide of carbon during the test (often one-fourth of the whole anthracen). To prove this, I give a few analyses of bisulphide of carbon test residues :—

1. { Product of CS_2 test } (= 100 by CS_2 test) } gave 49·64 { p. ct. pure anthracen by anthraquinon test.
2.   ,,   ,,   ,, 53·92   ,,   ,,
3.   ,,   ,,   ,, 55·64   ,,   ,,
4.   ,,   ,,   ,, 56·00   ,,   ,,
5.   ,,   ,,   ,, 59·06   ,,   ,,
6.   ,,   ,,   ,, 60·00   ,,   ,,

And I add the complete tests of two samples of crude anthracen by the bisulphide and by the anthraquinon test, to show the solubility of anthracen in bisulphide of carbon by the CS_2 test :—

(*a*). The sample gave 65 per cent anthracen by the CS_2 test, and 47·08 per cent by the anthraquinon test.

The insoluble in CS_2 gave 49·64 per cent pure anthracen.
   ,, soluble   ,,   ,, 42·37   ,,   ,,   ,,

Or—

65 insoluble of 49·64 p. ct. pure anthracen = 32·26 anthracen
35 soluble   ,, 42·37   ,,   ,,   ,, = 14·82   ,,

100   47·08

Therefore 14·82 of anthracen out of 47·08 in sample were dissolved by the bisulphide of carbon.

(*b*). Another sample of crude anthracen gave 64·12 per cent anthracen by CS_2 test and 48·79 per cent pure anthracen by the anthraquinon test.

The insoluble in CS_2 gave 59·9 per cent pure anthracen.
   ,, soluble   ,,   ,, 28·96   ,,   ,,   ,,

Or—

64·12 insoluble of 59·90 p. ct. anthracen = 38·40 anthracen
35·88 soluble   ,, 28·96   ,,   ,, = 10·39   ,,

100·00   48·79

10·39 anthracen, out of 48·79 in sample, were dissolved in CS_2.

As some objections have been raised against the correctness of E. Luck's anthraquinon test, I have submitted this test to an examination, and my experiments only confirm Luck's statements, viz., that chemically pure anthracen (which is very difficult to obtain from crude anthracen) yields, by oxidation with chromic acid, really the theoretic quantity of pure anthraquinon, and that all admixtures of crude anthracen consisting of products of distillation of coal are, by all well-conducted oxidations, either destroyed or transformed into substances which are soluble in dilute alkali. I have experimented on the following admixtures of crude anthracen.—Naphthalin, acenaphthen, phenanthren, carbazol, pyren, chrysen, and benzerythren. All these tar-products submitted to the anthraquinon test were transformed into substances soluble in dilute alkali.

When 10 grms. of chromic acid were used for the oxidation of 1 grm. of crude anthracen, I found that from some samples the anthraquinon was not quite pure, through insufficient oxidation, but by increasing the chromic acid to 15 grms. per 1 grm. of crude anthracen, and boiling for 3 hours, I have always obtained pure anthraquinon as the result of the test.

ON BISMUTH BROMIDE.
By R. W. EMERSON MACIVOR.

THE combination of metallic bismuth with bromine to form $Br'''Br_3$ is not, as is the case with antimony and arsenic, attended with the emission of light. The compound is prepared by heating finely-powdered bismuth with dry bromine in a hand-glass tube closed at the end.

Bismuth bromide, as obtained by this process, is a solid substance of a dark grey colour, fusing at a temperature of 198° to 202° C. to a dark red liquid which boils below a dull red heat. It is insoluble in carbon disulphide, alcohol, and ether. Hydrochloric acid dissolves it. By heating with nitric acid it is decomposed. It absorbs dry ammonia gas, with formation of a black non-crystalline solid body possessed of an extremely irritating smell. On exposure to the air, it absorbs moisture, and becomes of sulphur-yellow colour. Upon treatment with water it is decomposed, the products of the action being a white amorphous oxybromide and free hydrobromic acid. The oxybromide is insoluble in a solution of tartaric acid, and is decomposed on subjection to a long-continued process of washing with water, with formation of hydrobromic acid and bismuth oxide ($''Br_2''O_3 + XAq$).

Glasgow, 1874.

LABORATORY NOTES.
By GEORGE FOORD.

(1). *The Facile Use of Hydrofluoric Acid for the Decomposition of Natural and Factitious Silicates.*

IF an illustration were required for showing the great value of hydrofluoric acid, as a facile means for the solution and analysis of silicated compounds, perhaps no more striking example could be instanced than that described by Professors Kirchoff and Bunsen in their first paper on spectrum analysis, in which it is shown how a few grains of any mineral of the felspathic type, decomposed by hydrofluoric acid, and afterwards evaporated with excess of sulphuric acid, yields, on addition of water, a solution of the bases of the silicate, in which, if present, the potassium, lithium, sodium, strontium, barium, and calcium are readily recognisable in the spectroscope.

In expressing myself on this point, concerning the use of hydrofluoric acid, I feel that I ought to do so with great diffidence, as far, at least, as the arrangements and practice at present existing in the old country are concerned, having been so long absent from the latter; but, if I am correctly informed, the known danger of allowing the ordinary commercial hydrofluoric acid to come in contact with the skin still militates against its employment with that freedom which its usefulness would otherwise warrant.

A simple contrivance which I have employed for several years has brought the use of the acid so safely and completely under control that I have at last arrived at the view of its possible acceptability to others, and I therefore venture to describe it and suggest its adoption.

The proposed appliance is an addition to the ordinary gutta-percha bottle, in which the commercial hydrofluoric

FIG. 1.   FIG. 2.
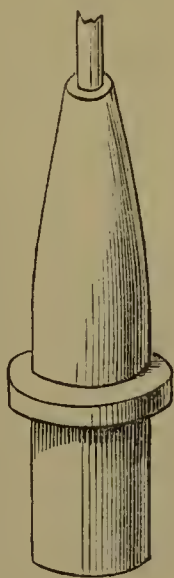
acid is commonly supplied, converting the vessel into a burette, from which the acid may be poured with precision, drop by drop, or in a thin stream, until the whole charge

of the bottle is exhausted. The burette-piece is formed out of gutta-percha tube, of a diameter sufficiently small for entering easily into the neck of the gutta-percha bottle. For making it, about $2\frac{1}{2}$ inches of such tube of, say, about $\frac{1}{2}$ an inch external diameter is cut off, and slit down in such a manner as to remove two wedge-shaped segments from either side of its diameter. A cylindrical piece of wood (the small end of an ordinary wooden penholder is suitable), of about $\frac{3}{16}$ths of an inch diameter, is now provided, and placed within the cut end of the tube, which latter is warmed and softened before a stove, and the two cut edges pressed together give to the tube a conical upper termination. A welt of gutta-percha, softened and applied round the warmed tube a little below the base of the conical portion, forms a flange for fitting down against the spreading top of the bottle neck. The cone is now warmed and carefully bent over to an angle of about 130° with the vertical portion, and, when cold and rigid, with a cork-cutter a circular perforation is made at the upper side of the bend. A piece of the same $\frac{1}{2}$ inch gutta-percha tube,

FIG. 3.
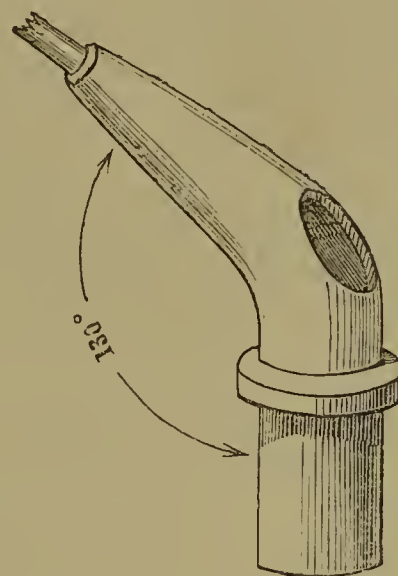
say, $\frac{3}{4}$ of an inch long, is now to have a wedge-shaped piece cut out through nearly its whole length, and, after warming, the cut surfaces are to be brought together and caused to unite so as to form a slightly conical tubulus the smaller end of which is to be warmed and applied, in the soft state, to the slightly-warmed opening at the bend of the larger coned tube. A stopper may now be made by cutting open about an inch of the same gutta-percha tube, softening and rolling it upon itself, shaping the lower end, and flattening and flanging the upper portion.

FIG. 4.
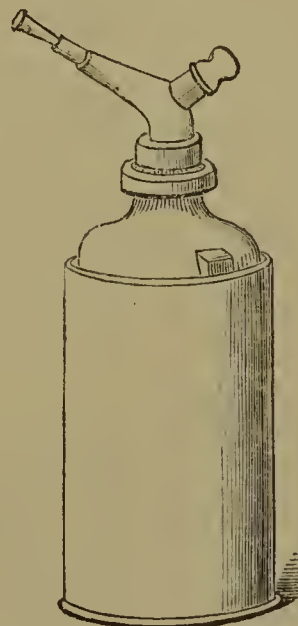
A piece of stout platinum foil is now to be rolled upon a wire of about $\frac{1}{8}$th of an inch diameter, so as to form a platinum tube, which may readily be soldered by a thin strip of fine gold foil laid on the joint and sharply heated before the mouth of the blowpipe. This platinum tube is

to be pushed into the coned opening of the gutta-percha burette-piece, and caused to adhere to it by gentle warming; the piece itself is to be adapted to the bottle by a layer of wax, kneaded until soft and pressed under the flange. The whole is pressed together, employing a warm spatula. if necessary, so as to secure a thoroughly good joint. Similarly, the stopper is fixed in with an interposed layer of wax; and a ball of wax, or little rod of gutta-percha or vulcanite, may be used for closing the tubulus when the vessel is set aside. A loose outer cylindrical case of tin-plate, reaching up to the shoulder of the gutta-percha bottle, with a cork wedge for fixing the latter, makes the arrangement completely secure, and the vessel as thus mounted can be used from day to day with the same facility as any other reagent bottle; a single drop of hydrofluoric acid can at any moment be obtained. The stopper allows access to the interior without disturbing the joint at the neck, although it may be added that after once fixing I have never yet found it necessary to remove this stopper.

(2). *Etching Glass Vessels.*

A few sentences concerning the use of hydrofluoric acid for etching chemical vessels in the laboratory may not be out of place here. Our beakers used in the gold assay for the " parting," when the number of assays is small, as well as pipettes and similar instruments, are readily etched by use of the above-described burette. Take the example of beakers; say twenty of them are required graduated for water ounces. Upon each is pasted a vertical strip of paper, and the graduations are marked on these strips with pencil, employing a flexible strip of metal as a rule. The beakers are next painted over the surfaces to be etched, at the side of the paper temporary scale, with a suitable varnish (photographer's black varnish, which is a solution of asphaltum in benzol, with mechanically-suspended vegetable biack, answers the purpose fairly, and has the advantage of rapidly drying). When the varnish is dry, vertical lines are ruled through it, and the graduations are ruled across from the paper scale, marking them in through the varnish, which operation is assisted by placing a white tile or paper under the vessel, so as to illuminate the markings from behind. The figures are now drawn in, and the vessels thus prepared are ready for bordering and etching.

The cement for bordering is made by dissolving resin in oil, and adding bees'-wax—the resin and bees'-wax in about equal quantities, and the olive oil in quantity sufficient for bringing the mixture, when cold, to about the consistence of tallow. When the fused mass has become cold, plaster-of-paris is kneaded in until the whole acquires a convenient plastic condition. The cement adheres less to the fingers after addition of the plaster; it can be softened at any time by kneading, and when pressed on to the glass surface it readily adheres to it. For the etching, the paper graduations are scraped off the glass, and rolls of the above cement are pressed on to the varnished glass surface, so as to enclose, without covering up, the lines and figures.

All the vessels thus prepared are now laid down, so as to present the portion to be etched in a horizontal position.

FIG. 5.
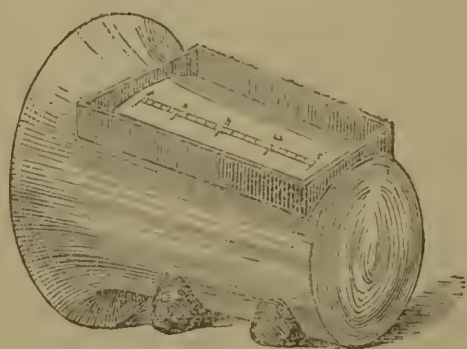
Three or four balls of the cement pressed against the sides of each vessel support it steadily, and at the same time

admit of delicate adjustment for level. The hydrofluoric acid is now poured on to each versel from the burette, and any air bubbles in the lines and figures are removed by means of a camel-hair pencil. Powdered fluor-spar may now be dusted on, so as to form a magma with the acid; its use is purely mechanical and precautionary, the chance of leakage through any defect of the bordering being reduced by this addition.

From ten to twenty minutes' action will give good bold engraving. The acid is then removed by immersing the vessels in a large vessel of water; the bordering is stripped off, and the varnish removed by rubbing with a rag steeped in a suitable solvent—in benzol, for example, when an asphaltic varnish has been used.

(3). *Wash-Bottle.*

The accompanying sketch shows a form of wash-bottle which I have had in use for over two years, and which may possibly prove as useful to others as it has been in my own work. The drawing, it is hoped, will require but

FIG. 6.
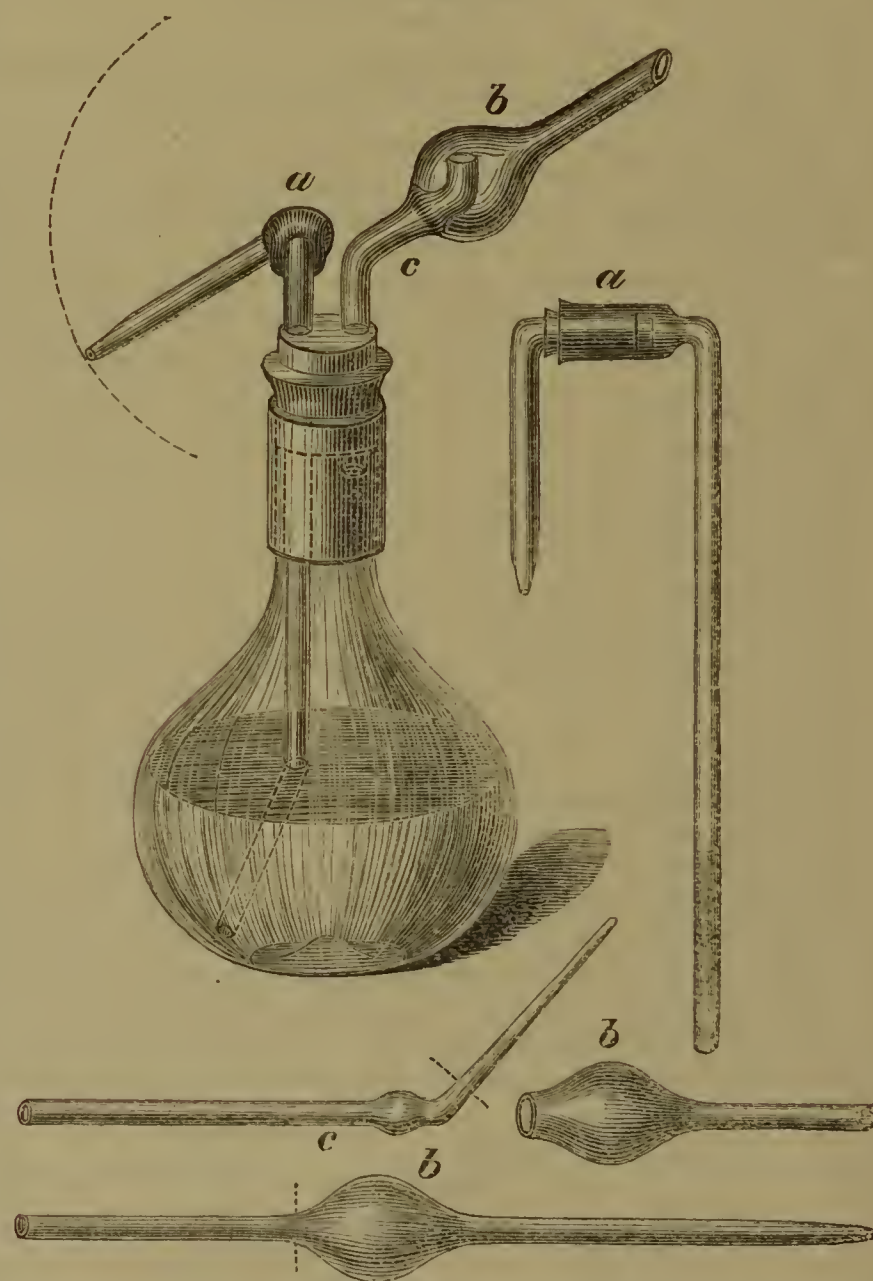
little explanation. The jet-tube is bent to a right angle, and is fitted, by means of a soft perforated cork, into the socket, *a*, of the supply-tube. This allows the jet to revolve on the axis of *a*; it may be set in any position, so that a stream of the wash-water may be projected upwards or downwards, or, in short, in any required direction, an arrangement which will be found of especial convenience in washing out precipitates from beakers and similar vessels, when these are inclined with the mouth downwards over a funnel or other receiving vessel.

The mouth-piece tube is blown with a trap, which prevents contamination of the distilled water during use. This mouth-piece is made by first blowing an egg-shaped bulb, then cutting off and widening out the opening of the latter, as shown in the bottom portion of the sketch. A second piece of tube is next drawn out, a small bulb is blown in it, and the drawn out portion is bent, or rather

curved, upwards, as shown in the sketch. The drawn out portion is now cut off at the position indicated by the dotted line, the cut edges are slightly rounded in the flame, and the curved tube is introduced into the larger bulb, the neck of which is now fused on to the shoulders of the smaller bulb. For the sake of durability, care should be taken that the glass is not left too thick at this joint. The ends of the tubes are now cut off to the proper length, the cut edges softened in the flame, the mouth-piece flattened, and the tube bent at the proper angle.

Melbourne, July 25, 1874.

NOTICES OF BOOKS.

The Worthies of Cumberland ; John Dalton, F.R.S. By HENRY LONSDALE, M.D. London : G. Routledge.

WHEN noticing the first series of this work, we expressed some surprise that in a publication treating of the worthies of Cumberland the name of John Dalton should be omitted. We were not then aware that a second volume was in preparation. The sage of Eaglesfield, we must admit, is no easy subject for the biographer.

There are men of less merit upon whom essays, orations, and *eloges* may be produced almost without trouble and without end. Not so here. Alike in his parentage, his person, his position, and his character, Dalton offers nothing to excite the reader's imagination. His career, free alike from intense lights and deep shadows, unmarked by the eccentricity, and versatility,—shall we say the showy faults ?—which often accompany genius, was singularly undramatic. He took no part in scientific or philosophic controversies. He was mixed up with no great public interests. He was neither persecuted nor petted, but for the greater part of his life simply neglected, after the orthodox English fashion. It was not his, combining the gift of expression with that of conception, to enchant his hearers with the eloquent exposition of scientific truths. He bequeathed us no aphorisms. He was not a brilliant experimentalist like Faraday or Mitscherlich. His researches, how great soever might be their ultimate value, even in a practical point of view, seemed, unlike those of Liebig, to have no direct bearing upon the arts and affairs of daily life. His discoveries could not, like those of his comtemporary Davy, be exhibited as striking lecture experiments. They must be apprehended not by the senses, but by the understanding.

To select such a subject is a proof of no small courage on the part of Dr. Lonsdale. That, despite all the difficulties of the task, and despite, too, the valuable biographies by Dr. W. C. Henry and Dr. R. Angus Smith, he has produced, not an *Ilias post Homerum*, but a valuable and useful work, is a matter on which we offer him our hearty congratulations. Dr. Lonsdale tells us in his preface that he writes not so much for the scientific public as for a " quasi-popular or less instructed class of readers." Having obtained much original information, hitherto unpublished, including a number of Dalton's letters, he is enabled to present "a more correct personal history of the famous chemical philosopher than has yet appeared in print." Still the discoveries of Dalton and their bearing on the recent development and present position of science have not been overlooked, " but rather epitomised and offered, as far as circumstances permit, in a form comprehensible to all persons of average intelligence." One melancholy thought haunts us as we turn over these pages. Was it well to allow such a man to waste his time and energies in the routine duties of elementary tuition, instead of devoting them entirely to original research ? How different would have been his position, and how much greater his opportunities, had he been born in Germany or Sweden ?

Our author shows no lack of enthusiasm for his subject. "As pilgrimages," he says, " to the shrines of saints draw thousands to the Continent, there may be some persons in the British Islands sufficiently in love with science, not only to revere the memory of its founders, but to wish for a description of the birthplace of a great master of knowledge—John Dalton—who did more for the world's civilisation than all the reputed saints in Christendom." This may, to some, seem strong language ; but the author can point in justification to the opinions of a number of the most illustrious men of the century, as quoted in his last chapter, to which the suffrages of many other and not less mighty minds might have been added.

It is known that in his sixty-eighth year Dalton was presented at court. The best thing the king, William IV, could find to say to him was :—

" Well, how are you getting on at Manchester ; all quiet I suppose ?"

Annual Report of the Board of Regents of the Smithsonian Institution for the year 1872. Washington : Government Printing Office.

THE constitution and objects of the Smithsonian Institution are doubtless well known to our readers. Like most scientific foundations, it has been compelled to attempt too much, public opinion and official influence diverting its attention from the *increase* almost exclusively to the *diffusion* of knowledge. It is now, however, freed from many of the burdens imposed upon it,—one of which would more than have absorbed its total income—and is pursuing a career of unmistakable usefulness. We cannot help asking, parenthetically, what would have been the fate of a similar endowment in England ? What would have happened if, for instance, Henry Cavendish had carried out his original design of bequeathing his property to the Royal Society, to be used in the furtherance of scientific discovery ?

The bulk of the volume before us consists of translations of certain papers read before leared bodies on the Continent. Most of these are highly interesting, though we do not quite understand on what principle the selection has been made made. We are particularly struck with the " Eulogy on Ampère " delivered by Arago, an admirable picture of the great French physicist both in the laboratory and in daily life. Those, however, who think of Ampère merely as a physicist, greatly misconceive him. He was also a chemist, a mathematician, a philologian, a botanist, a zoologist, a psychologist, and a poet. We find him busied with a universal language, the grammar and dictionary of which he almost completed. His memoir on probabilities has attained universal celebrity even though it may have failed to effect its moral object, *i.e.*, to convince gamblers of the utter impossibility of ultimate success. He was a profound student of the mental phenomena of the lower animals. We cannot refrain from quoting the anecdote which first opened his eyes to the fallacy of the vulgar notions concerning the intellectual and moral life of brutes :—" Being overtaken one night, not far from Montpellier, by a violent storm, I took refuge in an inn, in the first village I found on my road. The death of a lean chicken was the immediate result of this unexpected visit. The cook, placing the almost fleshless fowl upon the spit immediately tried to seize a terrier who was to turn it. The terrier absolutely refused to perform the duty assigned him ; he would yield neither to blows, threats, nor caresses. So much firmness attracting my attention, I inquired if the poor beast were making his first trial ? I was told that the dog had decided in his head that he and his comrade must divide the labours of roasting regularly between them. He was the last to turn the spit, and he now concludes that it is not his turn to work. The words *it is not his turn now*, seemed to me to include a world of meaning. At my request the stable boy was sent into the street to fetch the second dog. This one showed the most exemplary docility ; the rotatory drum received him, and he would soon have finished the task, if, wishing to complete the

experiment, I had not caused him to be removed in order to give the refractory dog a new trial. The refractory dog, *whose turn had now come,* obeyed the first signal of the cook, entered without resistance, and went to work like a squirrel in its cage." A thinker like Ampère who at once abandoned theories if he found them incapable of being harmonised with facts, saw at once the full meaning of this incident. His brilliant discovery of the mutual attraction of two wires traversed by similar electric currents is so well known that any explanation of its importance would be out of place. Less familiar is the fact that he appeared as the ally of Saint-Hilaire in his controversy with Cuvier on the unity of structure in organic beings. The latter, a much over-rated man, who in his "Animal Kingdom Arranged according to its Organisation" made the birds of prey to follow immediately after the whales, and placed the dull almost inanimate oyster higher than the social, reasoning, progressive ant, was yet, from his knowledge of details, his talent for exposition, and his untiring industry, a formidable opponent. It is interesting to find that Ampère held in a crude form the doctrine of development, now known in a more advanced phase as Darwinism, and now as then chiefly combated by ridicule. Wide as was the range of Ampère's studies, we must not confound him with the superficial amateur. He carried everywhere his characteristic profundity and originality of thought, and "touched nothing without adorning it."

The latter part of Ampère's life furnishes a striking illustration of the views put forward in Dr. Beard's recent work. He became not merely unwilling, but unable, to study, to write, or to read. He never could be prevailed upon to write out the title and table of contents for his work on the differential and integral calculus, and it appeared without them !

Following this *éloge* of Arago we find an account of the scientific labours of Edouard Lartet; a paper on the scientific education of mechanics and artisans ; an essay on organic bases; a paper by Prof. Kletzinsky on the "Nitrogen Bodies of Modern Chemistry" in which the different elements are symbolised by figures very much resembling German rolls (Semmel or Brödchen). We have, indeed, been told that such was actually the origin of graphic formulæ ; a learned professor at his breakfast-table, being smitten with the fancy for representing an equivalent of hydrogen by a single member of such a roll, and oxygen, nitrogen and carbon by two, three, or four cohering together. Surely Newton's apple must now fade into insignificance. Vegetable fibrin, we see, is given as a synonym for cellulose. We have always known this name to be applied to a nitrogenous albumenoid body. The annexed formula represents, further, only two of the atoms of hydrogen in cellulose as easily replaceable.

There is further a short scheme for the qualitative determination of substances by the blowpipe, by Mr. T. Egleston ; an interesting lecture on the boundary-line between geology and history ; papers on the principles of crystallography ; on meteorology in Russia ; on phenomena manifested in telegraphic lines during an Aurora Borealis ; on ethnology ; on ancient aboriginal trade in North America ; and on stone implements. We regret that space does not allow us to give a detailed analysis of several of these assays.

CORRESPONDENCE.

ASSOCIATION OF PUBLIC ANALYSTS.

To the Editor of the Chemical News.

SIR,—I am glad to see that the Association of Public Analysts appreciates the necessity of protesting the public and the chemical profession against incompetent persons obtaining analytical appointments. But, may I ask, How is the Association to ascertain the capacity of an analyst for appointment except by some examination test ? There

will be exceptional cases where the reputation of the candidate is a sufficient passport ; but, in other cases, what will be taken as good evidence ? We know, from experience in the Chemical Society, the deplorably loose way in which recommendations are given ; and even the fact of having practised analytical chemistry may be very insufficient evidence of ability. Suppose a gentleman appointed said to the Committee of the Association—" I am a Fellow of the Chemical Society ; I was for many years Professor of Chemistry in the Medical College of ———, and Chemical Examiner to the Government of ——— ; the chemistry of a country containing 25 millions of British subjects was entirely vested in me ; the life or death of hundreds of accused persons has depended on my chemical evidence." The statement being perfectly correct, there would apparently be the best possible evidence of capability. Yet I am sorry to say that, under the present system of Government chemical appointments, the statement would afford no proof of the candidate possessing the faintest capability. When I find two such chemical examiners working together, reported to their Government that a brandy of sp. gr. 0·907 had a true sp. gr. (after elimination of extraneous matters) of 0·952, that they had obtained this *true* sp. gr. by taking that " of a solution obtained by distilling 6 ozs., adding to the first 2 ozs. that came over 4 ozs. of distilled water to make up the original quantity," that in explanation they made bad worse by accusing the 1 per cent of sugar in the brandy of having *simulated* alcohol to the hydrometer test ; when the account of these chemical atrocities is published as a scientific contribution to a medical journal, I think that the Association may be warned against receiving any evidence of capability but the reputation earned by published investigations, or the results of an examination by competent authority.—I am, &c.,

EDWARD NICHOLSON.

Bangalore, Sept. 21, 1874.

CRYSTALLISATION OF PHOSPHORUS.

To the Editor of the Chemical News.

SIR,—In the " Notes and Queries " column of CHEMICAL NEWS, vol. xxx., p. 168, Mr. George Whewell, after referring to a paper of mine, " On the Preparation of Phosphorus Crystals," and to another on the same subject by Professor Lawrence Smith, both abstracted in the September number of the *Journal of the Chemical Society*, proceeds to describe the following experiment he made two years ago :—

In a tube filled with nitrogen was sealed up a piece of phosphorus, which, by melting before the fire, was caused to spread over the sides of the tube. In this tube, after a few days small crystals were noticed, which remained colourless four or five months, and then gradually turned lemon-yellow. At the present time a great number have disappeared, the tube having a small hole in it, caused by the expansion of the gas when sealing up the tube.

Allow me to point out that there is nothing new in preparing crystals of phosphorus by heating it in some gas having no action upon it, Mitscherlich[*] having thus obtained them, but too small for measurement, in 1855, and Blondlot[†] in 1866. Mr. Whewell states that, after melting the phosphorus, he placed the tube on one side without further application of heat ; but I should infer, from the rapidity with which the crystals formed in a tube in which the pressure was sufficient to burst a hole during sealing, that some of the phosphorus was present in the liquid state, probably in the form of small globules, which I have often observed remain liquid for months, in fact until reduced to microscopic points by volatilisation. The growth of crystals in tubes that have not been heated, and in which a slight rarefaction has been caused by the

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[*] *Annales de Chimie et de Physique* [3], xlvi., p. 301, from *Berl. Akad. Berichte*, 1855, p. 409; also in *Journ. Prakt. Chemie*, lxvi., p. 527.
[†] *Comptes Rendus*, lxiii., p. 397, Aug. 27, 1866.

absorption of the oxygen of the air originally contained, is so slow, that after months, and even years, they are scarcely visible to the unaided eye.

Crystals formed by the volatilisation of phosphorus whilst in the liquid state grow rapidly, but present a marked contrast to those produced by the spontaneous sublimation of solid phosphorus, either in vacuous or non-vacuous tubes ; for, whilst these are remarkable for their sharpness and distinctness, the former are always crystallised in a confused manner, the edges often much rounded, and the faces full of cavities. The change of colour to lemon-yellow noticed by Mr. Whewell was probably due to the action of diffused light, which has this effect, direct sunlight giving a ruby-red tint.

Mr. Whewell does not say that the hole, which, as I understand his description, was made at the very commencement of the experiment, was in any way covered to protect the phosphorus from the action of the atmosphere ; and I am rather at a loss to understand how he obtained crystals at all, at any rate " beautiful colourless crystals," under the circumstances.

I should, perhaps, mention that the paper of mine to which he refers was read at the forty-sixth meeting of German Naturalists and Physicians, at Wiesbaden, September, 1873, an abstract of the chemical proceedings at which appeared in CHEMICAL NEWS, vol. xxix., p. 103, and that the delay in publishing the mode of preparing large, regular, adamantine crystals of phosphorus by spontaneous sublimation in the dark, *in vacuo*, first employed, I believe, by me in August, 1870, arose from a desire to give at the same time good measurements of the crystals, the obtaining of which was a task surrounded by many difficulties. These will be appreciated when I explain that the crystals best adapted for measurement, though but little exceeding 2 m.m. in diameter, consisted of a combination of at least seven forms of the cubic system, having a total of about 218 faces ; that it was impossible to touch them for the purpose of adjustment without producing distortion, and that momentary exposure to the atmosphere was sufficient to destroy the brilliancy of the surface and render the smaller planes indistinguishable. All these difficulties, however, being at length overcome, most satisfactory measurements were obtained by Professor Maskelyne.

I am at present preparing a paper which I hope shortly to lay before the Chemical Society, on the sublimation of phosphorus, sulphur, and other bodies, under varying conditions of temperature, pressure, and light.—I am, &c.,

W. DOUGLAS HERMAN.

St. Helens, Lancashire,
Oct. 10, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 10, September 7, 1874.

Sixth Note on the Electric Conductibility of Woody Bodies.—Th. du Moncel.—In this paper the author examines the manner of rendering wood non-conductive—a question of some practical importance, since the only insulator free from brittleness hitherto known suitable for the construction of electric insulators is ebonite, a substance both costly and liable, in course of time, to an efflorescence of sulphur. Ivory and guaiacum wood, which are both relatively good conductors, become nearly non-conductive if stove-dried and saturated with certain oily and resinous liquids, which close up the pores of the bodies in question, and prevent moisture from penetrating within. Other kinds of wood can be modified in the same

manner. Sawdust of hard wood, agglutinated with blood, and submitted to a considerable pressure, so as to mould it into a solid tenacious body, like the hardened woods of M. Latry, is a good insulator for voltaic currents. After remaining six days in a damp cellar it showed no galvanometric deviation. Samples of wood baked and soaked in paraffin, and then exposed to moisture, were sensibly conductive. Wood stove-dried, and soaked in different varnishes, proved also still capable of re-absorbing moisture, and, consequently, of becoming conductive. Compression diminishes the conductivity of wood for the time being.

Existence of Zirco-Syenite in the Canaries.—M. Stan. Meunier.—On examining the geological collection brought by M. Webb from the Canary Islands, the author found that certain specimens of rocks from Fuertaventura were identical with the zirco-syenites of Scandinavia, especially from the neighbourhood of Christiania.

On Magnetism.—F. M. Gaugain.—(Conclusion.)[*]—The author has previously analysed the modifications produced in a horse-shoe magnet when its two limbs are rubbed with a bar of soft iron. When an armature of soft iron is applied to the polar surfaces of a horse-shoe magnet the magnetisation becomes augmented over all its extent. This fact appears incompatible with the theory of a magnetic matter condensed in the vicinity of the poles, and may thus be explained on the hypothesis of Ampère. The action of the magnet impresses on the molecules of the armature placed near the surface of contact a movement of rotation, which approaches them more or less to magnetic polarity. These act in the same manner upon the next layer of molecules, and the action is thus gradually propagated under the influence of both poles. The armature, thus become a magnet, reacts in turn upon the horse-shoe magnet, and impresses upon its molecules a rotatory motion, which brings them into positions more nearly polar than what they previously occupied.

Nature of the Sulphuretted Compound which Mineralises the Hot Springs of the Pyrenees.—E. Filhol.—The author quotes from a work of his, published in 1853, an experiment to prove that these springs owe their properties chiefly to the proto-sulphide of sodium.

On Chlorophyll.—E. Filhol.—The author has shown that solutions of chlorophyll, if treated with small quantities of hydrochloric acid, are split up in a remarkable manner. A blackish solid matter remains on the filter, whilst a yellowish brown liquid passes through, and is coloured an intense green by an excess of hydrochloric acid. This latter liquid, if filtered, leaves on the paper a yellow matter, whilst the filtrate is a pure blue. In case of dicotyledonous plants the black matter is amorphous. In all monocotyledons examined it is crystalline. These crystals are easily soluble in boiling alcohol at 85°. Cold alcohol dissolves mere traces. Ether, benzol, chloroform, and glacial acetic acid dissolve them readily in the cold. The colours of these solutions are not identical. Those prepared with ether and benzol are yellowish brown and fluorescent. Sulphide of carbon produces a yellow solution, less fluorescent. Chloroform gives a violet, and glacial acetic acid a violet-blue, both fluorescent. All these liquids, if examined with the spectroscope, show fine bands of absorption. These bands, the position of which varies a little with the nature of the solvents, are similar to those produced by chlorophyll itself, but do not occupy the same place in the spectrum. The yellow liquid obtained on filtering a solution of chlorophyll modified by hydrochloric acid does not show the slightest fluorescence. Hydrochloric and sulphuric acids, if concentrated, slowly dissolve the crystalline matter of chlorophyll, and produces solutions of a pure green, free from fluorescence. The spectrum of these solutions is so different from those obtained with less energetic solvents

[*] *Comptes Rendus* January 13, June 30, September 8 and 29, November 10 and December 22, 1873 ; and June 15, 1874.

that there is reason to assume a profound modification of the substance.

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Bulletin de la Societe Chimique de Paris, tome xxii., No. 2, July 20, 1874.

Action of Bromine upon Uric Acid; Contribution to the Study of the Isoalloxanates and of Murexide. Magnier de la Source.—Bromine attacks uric acid suspended in water, resolving it into urea and alloxan. If the temperature is allowed to rise during this reaction other products appear, among which are parabanic and oxalic acids, the former of which may thus be obtained in considerable quantities. By raising alloxan to the temperature of 240°, Hardy has succeeded in modifying this body, so that on combining with bases it gives rise to a series of coloured salts, the iso-alloxanates. These have been produced in the moist way as follows :—Uric acid suspended in forty to fifty times its weight of water is treated with bromine, which is added drop by drop till the liquid begins to grow clear. It is then poured into a capsule and concentrated in the water-bath, the delivery tube of an apparatus for disengaging hydrogen gas being carried to the bottom of the capsule. This gas sweeps away with it streams of hydrobromic gas, the liquid becomes perfectly colourless, and a carmine-red deposit begins to form on the sides of the capsule. If the evaporation is stopped, and the liquid treated with baryta water an abundant precipitate of a fine violet colour is formed at the bottom of the vessel.

Mineralogical Notes.—Antony Guyard (Hugo Tamm). —1. *Colouring Matter of Crude Nitres.*—Crudes nitres are frequently coloured sulphur-yellow or violet, both supposed to be due to organic compounds. The author finds that the yellow is merely chromate of potash, and the violet nitrate of manganese. Chromate of potash occasions the yellow colouration of the mother-liquors of saltpetre works.

2. *Existence of other Chromates in Nature.*—The masses of stoney matter which accompany raw nitres are often spotted with yellow. These yellow spots, earthy and never crystalline, are formed of mixtures of chromate of lime and chromate of magnesia in variable proportions. Thus the chromates of potash, of lime, and of magnesia may be added to the family of chrome minerals. The author has, however, never found chromate of potash except mixed with nitre.

3. *Existence of Periodate of Soda in Nature.*—Iodine exists in nitres as iodate of potash (not, as generally supposed, as iodate of soda or iodide of sodium). More rarely it is found as periodate of soda. When a nitre contains iodine, and its presence cannot be detected neither by the successive employment of chloride or nitrate of palladium and of sulphite of soda, nor by chlorine water and starch paste, it is because the iodine is in the state of periodate of soda. It is remarkable that when iodine is present as iodate it is almost always iodate of potash. When found as periodate it is always as periodate of soda, generally containing not a trace of potash.

4. *Sulphuricin.*—This mineral comes from Greece. It is a white porous silica, impregnated here and there with sulphur, and of a decided acid taste. Its composition is—

Sulphuric acid (free)	6·80
Sulphur	4·10
Water	6·10
Silica	80·38
Lime	1·25
Alumina	0·43
Oxide of iron	8·57
Magnesia	0·37
	———
	100·00

5. *Curious Mineral of Unknown Origin.*—This mineral, very hard and well agglomerated, is formed of an intimate mixture of small grains of chrome iron and of arsenio-sulphide of nickel. It contains—

Chrome iron	65·0
Arsenio-sulphide of nickel ..	35·0
	———
	100·0

Composition of the Hippomanes.—M. Yvon.—The author finds this production to consist of—

Water			76·19
Organic matter			9·21
Fatty matter..			1·64
Lime (oxalate and carbonate)			3·59
Ammoniaco-Magnesian-Phosphate.	2MgO .. 1·425		8·73
	PO_5 .. 2·530		
	NH_4O .. 0·926		
	12aq. .. 3·844		
Loss			0·36
			———
			100·00

Reclamation of Priority as to the Existence of the Formines, and on the Etherification of Formic Acid by means of the Polyatomic Alcohols, properly so-called.—M. Lorin.—The author maintains that he anticipated Tollens and Henninger in the description of glyceric mono-formin.

Analysis of a Calculus found in the Intestines of a Sturgeon.—B. Delachanal and A. Mermet.

New Volumetric Method of Determining Silver. —J. Volhard.—The alkaline sulpho-cyanides produce in salts of silver a clotty precipitate as insoluble in water as the chloride of silver. The red solution of ferric sulpho-cyanide produces the same precipitate, and is decolourised at the same time. If sulpho-cyanide of potassium or ammonium is added to the solution of a silver salt, mixed with a ferric salt, a red colouration appears, which is immediately decolourised, and does not become permanent until all the silver is precipitated. This indication is extremely sensitive, and the amount of silver is easily deduced from the quantity of sulpho-cyanide solution consumed in producing a permanent colouration if the strength of the sulpho-cyanide is known. This method, much more sensitive than that of Mohr, who employs chromate of potash as indicator, can be used for the determination of all bodies which are completely precipitated by nitrate of silver from an acid solution. It is merely requisite to add nitrate of silver in excess, and determine the excess of silver remaining after precipitation. To prepare the standard solution of sulpho-cyanide of ammonium—a salt too hygroscopic to be weighed directly— we dissolve about 8 grms. in a litre of water. On the other hand, 10 grms. of fine silver (or 10·8 if the solution is to correspond to the atomic weight) is dissolved in nitric acid, and diluted with water to 1000 c.c. To 10 c.c. of this solution add 5 c.c. of ferric sulphate (at 50 grms. Fe_2O_3 per litre), and dilute with 150 to 200 c.c. of water. The sulpho-cyanide solution is then dropped in with a burette till a permanent red colouration appears. If, *e.g.*, 9·6 c.c. of the sulpho-cyanide have been required, 960 c.c. of this solution are then diluted to make up 1 litre, when each c.c. will correspond to 10 milligrms. of silver. To assay an alloy of silver 1 grm. is dissolved in nitric acid, the solution evaporated in the water-bath, 5 c.c. of ferric sulphate and 200 c.c. of water added, and the sulpho-cyanide run in. Every 1-10th of a c.c. used expresses 1-1000th of silver. The presence of copper within certain limits is without influence. If it amounts to 80 per cent the precise point of saturation is difficult to seize, either because the blue colour masks the red colouration, or because the cupric solution has an action upon the sulpho-cyanide. It will be necessary to ascertain if the sulpho-cyanide undergoes any change in keeping, and if the presence of certain metals renders the result doubtful. Finally, this method requires simplifying for alloys rich in copper and poor in silver. This simplification may be

found, perhaps, in the following reaction :—When to a mixed solution of copper and silver ferro-cyanide of potassium is added, the brown precipitate of ferro-cyanide of copper does not appear till all the copper has been thrown down.

Detection of Dyes upon the Fibre.—M. F. Fohl.—Reserved for insertion in full.

No. 3, August 5, 1874,

So-called Colloid Matter of Tissues in course of Degeneration.—MM. Gautier, Cazeneuve, and Daremberg.—An interesting chemico-physiological paper, but not adapted for abstraction.

Etherification of Glycol.—M. Lorin.—The reciprocal action of oxalic acid and of glycol is analogous to that of glycerin. The formines are partially eliminated, and diformin is found in the formic acids produced ; these formines are obtained again by the substitution of formiate of potash for acetate in the preparation of glycol.

The Isomeric Compounds C_2H_4IBr.—M. C. Friedel·—Not suitable for abstraction.

New Eudiometer.—M. A. Dupré.—This paper ought to have been accompanied by a diagram.

Urometer and Azotometer.—M. A. Dupré.—A modification of Yvon's apparatus for determining urea by means of the hypobromite of soda.

Action of Sulphuric Acid upon Lead.—A. A. Mallard.—The lead employed in these experiments consisted of—

Lead	99·62
Antimony	0·14
Iron	0·03
Matters not determined ..	0·21
	———
	100·00

The acid employed was of an ordinary quality, containing traces only of nitrous acid. Sulphurous acid was not present. The incompatibility of sulphurous acid, and of traces of nitrous acid dissolved in sulphuric acid, is not absolute. Both have been found simultaneously present. Acids below 61° B. were gradually concentrated by ebullition until they reached 205° C., the point at which acid of that strength boils. They then attack lead, yielding merely sulphurous acid and sulphate of lead. Acids above 61° B., and below 65·5° B., are concentrated by ebullition up to 320° C., the point at which acid of that strength boils. They then attack lead, producing sulphurous acid, sulphate of lead, and a little sulphur. Acid of 65·5° B. attacks lead at 250° C., yielding sulphurous acid, sulphate of lead, and sulphur.

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Revue Universelle des Mines, de la Metallurgie, des Travaux Publics, des Sciences et des Arts Appliques a l'Industrie, July and August, 1874.

This number does not contain any original chemical or physical matter.

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Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, No. 3, 1874.

This number is chiefly taken up with the speech of M. Wurtz on " The Theory of Atoms in the General Conception of the World," as delivered at the Lille meeting of the French Association for the Advancement of Science.

No. 4, September 24, 1874.

This number contains a recent speech delivered before the Academie des Sciences by M. Chevreul, and given by M. Moigno as an antidote to the celebrated Belfast speech of Dr. Tyndall.

Optico-Acoustic Phenomena.—In the *Journal of the Franklin Institute* Prof. A. Dobleur describes a very ingenious instrument for demonstrating optico-acoustic phenomena. He takes a tube of any material, 1 to 2 inches in diameter, and 14 inches long, or more. On one of the ends he applies a membrane of silk-paper, fine ribbon, or gold beater's skin. In the centre of this he fixes with gum a piece of looking-glass, not more than an eighth of an inch square, with the reflecting side turned outwards. When dry, it is turned to the sun-light, the open end of the tube is put in the mouth, holding the other end in such a manner that the ray of light reflected may fall upon a white wall or on a sheet of paper. If the operator then speaks or sings into the tube, the regular motion of the ray of light presents very pleasing and regular designs, which differ according to the intensity of the sound, but which are always uniform under the same conditions.

Production upon Wood of Photographic Proofs destined for Engraving.—M. T. C. Roche.—The block of wood is first covered with a layer of gelatin (0·39 grm. to 31 grms. of water) by means of a soft brush. When this coating is dry it is covered, in the dark, with a solution prepared of—(1) Red prussiate of potash, 7·80 grms.; water, 62·20 grms. (2) Ammonio-citrate of iron, 9·10 grms. in 62·20 grms. water. These solutions are mixed and filtered, and the mixture is kept in the dark. When the layer is dry it is exposed under a negative for ten to twelve minutes, and washed with a soft sponge, when a blue image appears. If thus prepared the coating does not shell off under the graver.

Carbonised Wood.—M. Hirschwald, on visiting a gallery in the Clausthal mines, abandoned for 300 to 350 years, found some wood which had been left there. It had absorbed the waters which flowed in the interstices of the schists, and had become of a brown colour and coriaceous texture. On exposure to the open air it quickly hardened, and was completely transformed into brown coal (lignite) with a conchoidal fracture. Its percentage of carbon was very similar to that found in the best Saxon lignites. This observation shows that the circumstances favourable to the natural carbonisation of wood are—(1) Situation among fragments of rocks among which circulate freely subterranean waters impregnated with metallic salts. (2) A constant and relatively elevated temperature, such as prevails in deep excavations. (3) Continuous pressure.

No. 5, October 1, 1874.

This number contains no original physical or chemical matter.

No. 6, October 8, 1874.

This number contains no chemical or physical matter which has not been noticed in the CHEMICAL NEWS.

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Reimann's Farber Zeitung, No. 36, 1874.

This number contains a continuation of the instructions for dyeing with coal-tar colours, from which we extract the following :—

Gris d'Argent on Cotton.—Dissolve in boiling water, and sour slightly with sulphuric acid. Begin to dye cold, and raise slowly to a boil; rinse well. 10 to 15 grms. serve for 1 kilo. of cotton.

Artificial Indigo on Wool.—Take colour to 5 per cent of the weight of the cotton, and add an equal weight of acetic acid. Boil for two hours. If a darker shade is required, top with logwood. After dyeing, clear in very dilute sulphuric acid.

Jaune d'Or.—Dissolve in boiling water. For wool, begin cold, adding a little oxalic acid, and raise to a boil. This colour is a substitute for turmeric and fustic in modifying orchil browns. If a jaune d'or ground is topped with magenta a tolerably fast shade is obtained, closely resembling scarlet. 1 grm. of colour is sufficient for 1 kilo. of goods.

Cotton Blue without Mordant.—Dye on bleached cotton. Before dyeing pass through alkaline water (am-

monia or soda), rinse, enter in the dye-beck cold, and acidified with sulphuric acid. Heat slowly to 40° R., and let cool again. 15 to 20 grms. serve for 1 kilo. of goods. This colour is also applicable to silk.

There are also receipts for a bright medium green on garments (cotton warps); for an aniline-violet and a Nicholson blue on the same material; for a fast and an inferior mode grey on woollen yarns; instructions for dyeing a macarat and a brown on pecking-cloth; a fast sanders-wood red on linen; catechu browns for calico-printing; and a black for felt hats.

MISCELLANEOUS.

Metropolis Gas Supply.—Dr. Letheby, the Chief Gas Examiner appointed by the Board of Trade, has recently reported to the Metropolitan Board of Works and the Corporation of London on the quality of the gas supplied to the Metropolis by the Chartered, the Imperial, and the South Metropolitan Gas Companies, during the quarter which ended in September last. He reports that the average illuminating power of the Chartered Company's common gas has been as follows at the several testing-places, namely:—18·0 standard sperm candles at Beckton; 17·05 candles at Friendly Place, Mile End; and 16·89 at Ladbroke Grove. That of the Imperial Company has been equal to 16·89 candles at Carlyle Square, Chelsea; 16·07 candles at Camden Street, Camden Town; and 17·93 at Graham Road, Dalston. And that of the South Metropolitan Company has been equal to 15·58 candles at Hill Street, Peckham. The Cannel gas of the Chartered Company, at Millbank, Westminster, has been equal to 21·28 standard sperm candles. The gas, therefore, of all the companies has been constantly above the requirements of the several Acts of Parliament of 1868 and 1869. As regards purity, Dr. Letheby reports that the gas has been at all times free from sulphuretted hydrogen, and that the average amounts of sulphur in other form than this was as follows:—11·41 grains per 100 cubic feet of the gas at Beckton; 8·68 grains at Friendly Place; 17·95 grains at Ladbroke Grove; 17·02 at Millbank; 19·26 at Carlyle Square; 13·04 at Camden Street; 14·84 at Graham Road; and 12·94 at Hill Street, Peckham. On three occasions there was an excess of sulphur in the gas, namely—on the 30th of July last, when the gas of the Chartered Company, at Ladbroke Grove, contained 26·4 grains per 100 cubic feet; and on the 23rd and 26th of September, when the gas of the Imperial Company, at Bruce Terrace, Bow, contained a fraction of a grain over 20 grains per 100 feet. The slight excess in the last case was due to accidental cause from the beginning of operations at the new works. The proportions of ammonia in the gas were always below the fixed maximum of 2·5 grains per 100 cubic feet—in the Chartered gas it ranged from 0·02 to 1·46 grains per 100 feet; in the Imperial from 0·0 to 0·37 of a grain; and in the South Metropolitan it averaged 0·42 of a grain. The average results, therefore, of the testings of the gas of the several companies were fully equal to the requirements of the Acts of Parliament.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the separation and utilisation of certain mixed chemical products. C. Lowe, manufacturing chemist, Reddish, Lancaster. February 3, 1874.—No. 425. To carry out the object of this invention I take the dilute acid liquors containing sulphuric acid and picric acid obtained in the manufacture of picric acid as a lye product, and concentrate the said dilute acid liquors by rectification in any suitable vessel or vessels.

Improvements in and connected with the manufacture of sulphates of soda and potassa, and in apparatus or appliances employed therein. James Hargreaves, chemist, and Thomas Robinson, iron founder, Widnes, Lancaster. February 4, 1874.—No. 448. This consists of certain novel combinations and arrangements of parts, whereby the manufacture of sulphates by the patentees' well-known direct-action

process is facilitated and cheapened. First. One of the uptake connecting pipes opens into a high-level flue. Second. A steam pump is used to draw the gases through the converting chambers. The capacities of the steam and pump cylinders are such that about one volume of steam is used for every ten volumes of gas exhausted. The exhaust steam is superheated and mixed with the sulphuric acid. Third. Slide grids with a projection or projections fit hinge-like into a cavity or cavities on the back support, and allow the grids to fall and the sulphates to be easily removed. Fourth. The heated gases or products of combustion are caused to pass by a syphon from between the cylinder top and covering plate into the converting chamber, being filled thence down through an opening in the bottom plate of one of the drawing doors to a chimney. In this way the chloride in or being filled into a chamber is prevented from being damped by condensation, and is heated by direct contact with heated gases. Fifth. The outsides of the side grids are made without perforations for from 6 to 10 inches, so as to assist in forcing a stronger current of gas through the centre of the mass in a chamber. Sixth. For condensing the hydrochloric acid evolved, an oblong tower connected to a set of tubular syphons is used. These syphons are connected with a second oblong tower, upon which is erected a wash-tower to condense the last traces. The tower is built of specially formed acid-resisting bricks or stones. Such bricks or stones form tubes, being rammed with a mixture of tar and clay, or other suitable material impermcable to acid. Seventh. The converting chambers are each speedily filled from a hopper fitted with a sliding or removable shutter. Eighth. The syphons connecting the flues and chambers are made in two pieces. The joints are made good by two plates, one with an aperture therein to allow the gas to pass when desired, and the other, without an aperture, to close the passage. Ninth. An aperture is formed on the end of each of the syphons, which enter the converting chambers, and air admitted therethrough to cool the chambers should they be allowed to become too hot. The said aperture is provided with two covers, so that by turning one, the area of inlet may be varied at pleasure. Tenth. The chambers are built in two rows at a suitable distance apart, so as to allow drawing of sulphates from the chambers at both sides. The gases after passing through one of the rows of chambers are taken through a connecting pipe to the other row, and, if necessary, back by a second pipe to the first row. Eleventh. To utilise waste heat from the sulphate apparatus, and provide means for drying the chloride into hard lumps, we place iron plates with flue spaces beneath them on the top of the arch between the two rows of chambers described under the tenth head.

Improvements in the manufacture of the several oleates of potash, soda, and ammonia, commonly known under the name of soluble oil, and applicable in the process of finishing printed calicoes and silk goods, and other cotton and silk dyed goods, and velvets. Charles Watterson, manager to James Marshall Beckett, manufacturing chemist, Vickers Street, Miles Platting, Manchester. February 4, 1874.—No. 456. The invention consists in the treatment of olein or oleic acids, distilled or obtained by pressing, from all or any sources, especially from cocoa-nut oil, palm oil, cotton-seed oil, castor oil, and olive oil and nut oils, with caustic soda, potash, or ammonia, in the following manner, viz.:—I place about a ton of castor oil, olein, or oleic acid into a pan capable of holding three tons, to which I add about 8 cwt. of caustic soda, containing 22 per cent of alkali, and 200 gallons of water. I boil the mixture slowly twelve hours, after which I add about a ton of cocoa-nut oil olein, then 5 cwts. or thereabouts of caustic soda, and boil the mixture thus obtained for ten hours; I then add 3 gallons of strong ammonia or caustic potash at 60° (Twaddle's hydrometer). I then make the total bulk with water up to 3 tons, adding potash, or soda, or ammonia, for the purpose of suiting the mixture to the purpose for which it is required. This composition gives a brighter colour and softer feel to the cloth than is obtainable from the ordinary oils, tallows, and soaps now in use.

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ON THE
TRUE RELATION BETWEEN THE WEIGHTS, VOLUMES, AND SPECIFIC GRAVITIES
OF THE
COMPONENT ELEMENTS, AND THOSE OF THE COMPOUND, IN CHEMICAL COMBINATIONS.

By Sir F. C. KNOWLES, Bart., M.A., F.R.S.

HAVING been recently engaged in an enquiry which required the determination of—(1) The ratio of the sum of the volumes of oxygen gas and of vapour of carbon (together forming carbonic oxide) to the volume of carbonic oxide; (2) the ratio of the sum of the volumes of carbonic acid and of vapour of carbon, producing together carbonic oxide, to the volume of carbonic oxide so produced; (3) the ratio of the sum of the volumes of carbonic oxide and oxygen gas due to its perfect combustion, to the volume of carbonic acid so produced—all under the same conditions of temperature and pressure—I sought for information on the subject both in works of reference and from reputed chemists. I was much surprised to find that the answers to my enquiries were all of them at variance with known chemical data and relations, and that they led in some cases to conclusions palpably absurd. Upon going into the matter more deeply and exactly, I found that either I had taken the term "atomic volume" in a wrong sense, or that a fallacious conclusion had crept in and had obtained credit among chemists to the effect "that the *numerical* relation between the atomic *weights* and that between the atomic *volumes* are identical." Upon further reflection, I came to the conclusion that the exposition of this fallacy, if, as I think, such a fallacy exists, has a bearing far more important than upon the special subject which led me to perceive it. At present all the laws of chemistry with which we are acquainted, though based on the strictest induction, are more or less empirical. We know nothing of the mode of collocation of two or more primary atoms which produce a secondary atom or molecule; we know the combining weights of the substances, and in many cases also their specific gravities; that is all. It has struck me very forcibly that our path to the knowledge of the collocation must lie through the relation, if discoverable, between the specific gravities of the component atoms and that of the compound molecule, and is to be sought there in the first instance. This relation will certainly be obscured by any false conception which may prevail as to the relation of the volumes of the component elements to that of the compound body. If, after a comprehensive survey of the whole field of chemical combinations, we could by some happy hypothesis so succeed in grouping the phenomena as to be able to determine *à priori* the specific gravity of a molecule from the specific gravities of its constituent atoms, we should so far have succeeded also in converting chemistry into a deductive science.

The fallacy to which I have referred may be thus stated in an algebraical form:—

"Let $A+B=C$, then will also $\frac{A}{a}+\frac{B}{b}=\frac{C}{c}$."

In the supposed case, A, B, C would represent atomic weights, a, b, c the respective specific gravities of the components and of the compound. Now, it is true that these two conditions may co-exist, but only on condition of a certain relation existing between A, B, C and a, b, c, which is readily determinable. This is expressed by the equation deducible from the former two—

$$\frac{A}{B} = \frac{1-\frac{c}{b}}{\frac{c}{a}-1}.$$

As negative values are to be excluded, we must have either—

$$1 > \frac{c}{b} \text{ and } 1 < \frac{c}{a},$$

or—

$$1 < \frac{c}{b} \text{ and } 1 > \frac{c}{a}.$$

Now, it is scarcely necessary to say that such conditions can rarely, if ever, obtain, and are in no case known to obtain. Let us take an application of this test.

It was stated to me that, "when a given weight, C, of carbon unites with a given weight of oxygen, O, to form $C+O=CO$, the *volume* of CO is double of the *volume* of O." The density of air being 1, that of O is 1·6, that of CO being 0·9706. (The specific gravities referred to water will, of course, be all the same multiples of these.) The volumes must be equal to the weights divided by their respective specific gravities or densities. Let x be the density of the vapour of carbon; then, if the above statement be correct, we must have—

$$\frac{C}{x} + \frac{O}{1·6} = 2 \times \frac{O}{1·6}.$$

This gives—

$$\frac{C}{x} = \frac{O}{1·6} \text{ and } x = 1·6 \times \frac{C}{O} = 1·6 \times \frac{6}{8} = 1·2.$$

But we must have also—

$$\frac{2O}{1·6} = \frac{C+O}{0·9706};$$

from this we readily deduce—

$$\frac{C}{O} = 0·21325,$$

which is in direct contradiction to the known ratio of—

$$\frac{C}{O} = \frac{6}{8} = 0·75000.$$

The assigned ratio of the volumes is, therefore, erroneous.

Now, the real question is this. "The density of O being 1·6, and that of C being x, how are we so to *pack* the weights C and O in space as to give a weight $C+O=CO$ with a density of only 0·9706?"

It cannot signify, so far as the solution of this problem is concerned, whether or not there be an attraction between the atoms of C and those of O, as it depends only on the diffusion in space of the aggregate weight of C and O, and we may for this purpose, when the atoms have taken up their new position, conceive the volumes to be simply added together, each comprising its own atoms, but so that the whole volume compared with the whole weight may give the required density, 0·9706.

This is stated in the equation—

$$\frac{C}{x} + \frac{O}{1·6} = \frac{C+O}{0·9706};$$

and on solving the equation we find 0·636 for the density of the vapour of carbon, that of air being 1. It will be interesting to determine experimentally the ratio of the new volume to that of O; our solution makes it as 1 : 2·8848.

Again, the statement was that "1 *volume* of carbonic acid added to 1 *volume* of carbon vapour formed 2 volumes*

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* We may test this proposition by assuming it to be true, and leaving for determination accordingly the value of x, the density of the vapour of carbon. This gives—

$$\frac{C}{x} + \frac{C+2O}{·1529} : \frac{2(C+O)}{0·9706} : : 1 : 2.$$

This, being reduced to an equation and solved as to x, we obtain $x=165$.

of carbonic oxide," this being the actual relation of the equivalents ; but, adopting the above value for the density of C, 1·529 being that of CO_2, we have the ratio of the volumes—

$$\frac{C}{0\cdot636} + \frac{C+2O}{1\cdot529} : \frac{2(C+O)}{0\cdot9706} = \frac{6}{0\cdot636} + \frac{6+16}{1\cdot529} : \frac{2(6+8)}{0\cdot9706},$$

which gives a ratio of about 100 to 120, being an expansion of only one-fifth. We see plainly here that the numerical relation of the *equivalents* has been extended to the *volumes*, as if, in the equation $(C+2O)+C=2(C+O)$, it did not signify whether CO and $\overline{C+O}$ represented weights or volumes.

Lastly, in forming $CO_2=C+2O$ by the combustion of $\overline{C+O}$ with O, the volume was said to undergo no change. This was obviously a mistranslation of " one atom of CO added to one atom of O forms one atom of CO_2," into " one *volume* of CO added to one *volume* of O forms one *volume* of CO_2." But the correct statement, in numbers according to the real data of the case, is the ratio (C=6, O=8)—

$$\frac{C+O}{0\cdot9706} + \frac{O}{1\cdot6} : \frac{C+2O}{1\cdot529} : : \frac{14}{0\cdot9706} + \frac{8}{1\cdot6} : \frac{22}{1\cdot529},$$

which gives, to *two* decimal places, the ratio of 135 : 100, showing a contraction of somewhat more than *one-fourth*. This determination involves no hypothesis as to the distribution in space of the constituent atoms, and is a mere translation of the facts into a numerical form. (The volumes are supposed to be referred to a common temperature and pressure.) I subjoin an abstract of desiderata.

NOTE.—The property of sulphuric acid in virtue of which, upon dilution with water, a great contraction of the sum of the original volumes of acid and of water takes place after mixture, with the evolution of considerable heat, might be enlisted in some useful experiments upon the varying specific gravities due to different successive collocations of the molecules, and upon the corresponding heat evolved.

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Desiderata for Experiment.

(1). A physical volume of pure oxygen of 100 cubic inches at the mean pressure and temperature, and therefore of known weight, is saturated with carbon in a closed vessel by means of the voltaic current, carbonic oxide (CO) being formed. This product is allowed to cool down to the initial temperature of the oxygen. Required the volume in cubic inches of the resulting carbonic oxide ?

(2). A given physical volume of carbonic acid gas, say, 100 cubic inches, in a closed vessel, is placed over carbon ignited by the electric current until it is converted into carbonic oxide. This carbonic oxide having cooled down to the initial temperature of the carbonic acid gas, required its volume ?

(3). A given physical volume of carbonic oxide gas, say, 100 cubic inches, and therefore of known weight, is mixed with a volume of oxygen of the same temperature, and having its weight $=\frac{8}{14}$ths of the weight of the original carbonic oxide. The electric current is passed through it until carbonic acid gas is formed. After cooling down to the original temperature of the gases, required the resulting volume of the carbonic acid formed ?

Mayfield, near Ryde,
October 8, 1874.

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Now, the weight of a cubic foot of air is about 1·2 ozs., which makes that of a cubic foot of vapour of carbon=198 ozs., or 12 lbs. 6 ozs., heavier than a gallon of water, which weighs only 10 lbs.! Again 1 cubic foot of carbonic acid gas, itself consisting, *by weight*, of 6 of carbon and 16 of oxygen, weighs only 1·2×1·529 ozs., or 1·8348 ozs. This shows the absurdity of the proposition.

ON THE
RAPID ESTIMATION OF PHOSPHORIC ACID, MAGNESIA, AND LIME.
By M. G. VILLE.

DURING the last fifty years our great industries have for the most part transformed their methods of work, and have succeeded at the same time in rendering them more expeditious and economical. Chemists have admitted very little change in the processes that they received from the great French school of the commencement of this century. If we mentally pass in review the descriptions in which are tabulated the results of laboratory work, we find that they can all be reduced to seven or eight categories—weighing, dividing, pulverising, heating, calcining, dissolving, precipitating, and filtering. The idea of simplifying, and especially of expediting, these various operations, by means of appropriate apparatus, has always been with me a favourite subject.

In the present paper I will describe a means of rapidly separating a precipitate from the fluid in which it has been generated.

If I add that, by the help of apparatus, the adoption of which I have suggested to chemists, I can estimate a large number of bodies—for example, lime, magnesia, phosphoric acid, and probably potash—with the utmost accuracy, and with a rapidity that could never be attained by the old method, it seems to me that this result is quite of a character to encourage others to follow up this line of enquiry, which, although humble, is nevertheless indispensable.

I will first treat of the estimation of phosphoric acid.* This estimation has been for a long time one of the most laborious and delicate of mineral analyses when the phosphates are mixed or united with iron, and especially with aluminium.

It is true that at this time the question is more advanced. Since Mr. Warington, and above all M. Brassier, have drawn the attention of chemists to the property that citrate of ammonia possesses in the highest degree of dissolving oxides of iron and aluminium, we can isolate phosphoric acid in the state of ammonio-magnesian phosphate. For this it is sufficient to add to the liquid resulting from the attack of a phosphate by weak hydrochloric acid, first some citric acid, then ammonia in excess, and lastly chloride of magnesium. In order to be correct, however, it is necessary to observe that this method has only commenced to be generally used in laboratories since M. Boussingault has shown that the presence of lime did not alter the accuracy of the results. This very accurate process is inconveniently long ; the filtration is slow.

On the other hand, M. Leconte has proposed to estimate phosphoric acid by the volumetric method by means of salt of uranium. The accuracy of this process leaves nothing to be desired, but it cannot be employed in the presence of iron or aluminium.

Last year I had to perform a great number of analyses of phosphates. I tried to unite these two methods, and take from each its advantages—from that of Mr. Warington and M. Brassier, the accurate separation of aluminium and iron ; from that of M. Leconte, delicacy and certainty of estimation, and the suppression of weighings. My new apparatus for rapid filtration has added to these advantages that of quickness.

I attack in the cold 2 grms. of phosphate with 50 c.c. of hydrochloric acid or weak nitric acid, and filter it. I take 5 c.c. of this solution, add at first some citric acid, then ammonia in excess, and lastly precipitate by a solution of chloride of magnesium, the liquid being maintained ammoniacal.

The phosphoric acid deposits in the form of ammonio-

———

* I for the first time described this method, apparatus, and reactions in a patent invention of August 29th, 1871, under the number 4300, in order to take date. The description I now give is extracted, word for word, from my patent.

magnesian phosphate. By means of the exhausting filter I separate it from the supernatant liquid, wash it with ammoniacal water, exhaust again, and finally dissolve the precipitate, by means of some drops of nitric acid, and estimate volumetrically by means of acetate of uranium according to M. Leconte's process, to which I have made several useful additions.

Thanks to my new apparatus, the union of the two methods is complete, and the quickness of the process is such that, in less than two hours, ten estimations at the least can be made.* The estimation of phosphoric acid becomes as easy as that of nitrogen by soda-lime, whilst it is more general and not less accurate.

Suppose we have to analyse superphosphates of lime of commerce. The necessity of distinguishing phosphoric acid which is in the soluble state from that which is in the insoluble state requires two parallel attacks, one with distilled water, and the other with weak nitric acid. The operation is always the same. We work on each liquid separately, as I have just pointed out in the case of natural phosphates.

I will now describe the apparatus that has so much expedited the work. A glance at the drawing is sufficient to understand their arrangement and mode of action (Fig. 1).

FIG. 1.
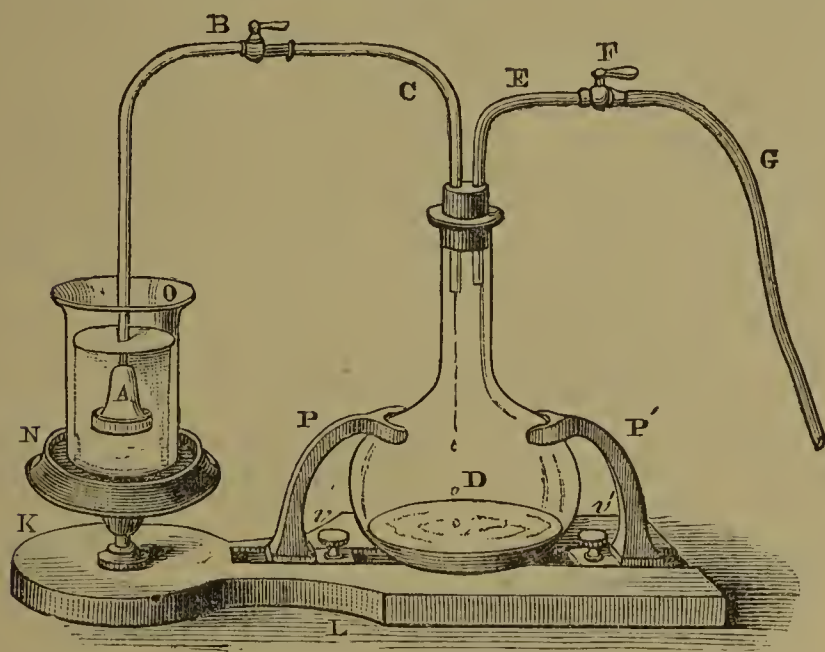
FIG. 1 A.
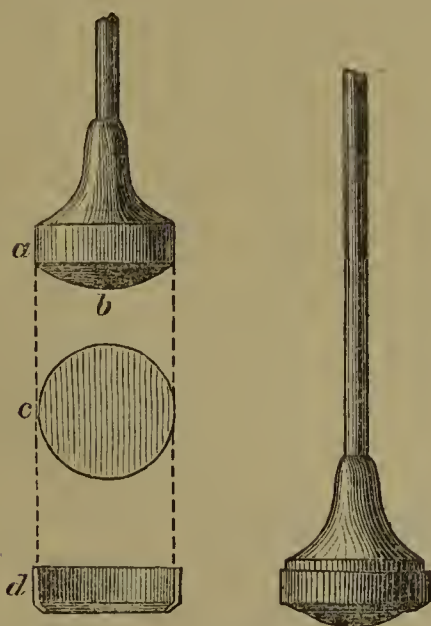
An exhaustion is formed equal to some centimetres of mercury in the globe, D, by the help of a small hand-pump. The base of the cone, A, covered with one or two discs of blotting-paper, held in place by a ring fitting tightly by friction, works as a true filter, which acts under pressure.

* In a recent work, M. Joulie, placing in another point of view the difficulty of obtaining exact results by the gravimetric method, has proposed the previous precipitation of phosphoric acid in the state of ammonio-magnesian phosphate, which he afterwards estimates volumetrically.

M. Peligot formerly made use of a similar arrangement to separate the tribasic saccharate of lime from its mother-liquor; and M. Berjot has had recourse, more recently, to a vacuum for rapidly estimating the oil in seeds by means of sulphide of carbon.

I have adopted two forms of apparatus, one of platinum and the other glass (Fig. 2). The fragility of the latter is

FIG. 2.
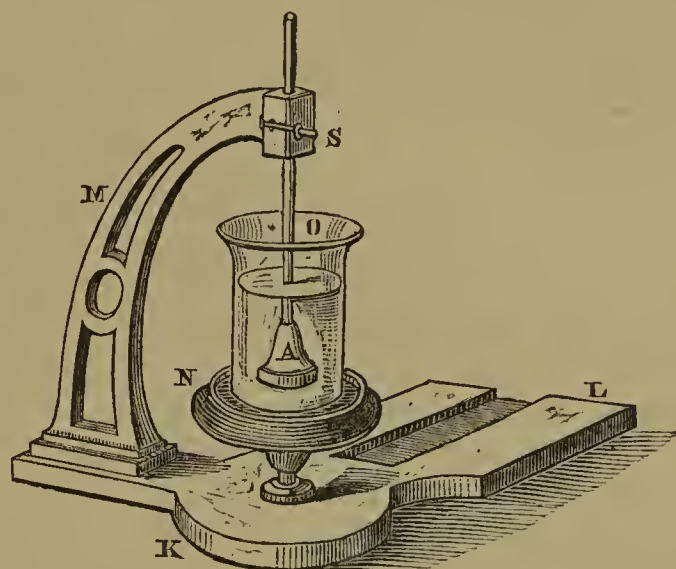
obviated by means of the consolidation arm, M, which firmly fixes the exhausting tube.

The facility which this method gives of multiplying estimations has led me to define, experimentally, all the conditions which could affect the precipitation of the ammonio-magnesian phosphate. Among other results, I have discovered a means of rendering the precipitation almost instantaneous. To effect this, it is necessary to operate on a moderate quantity of phosphate, and to employ an excess of chloride of magnesium. With a small quantity of chloride the precipitation is slow, with more it is quicker, with an excess it is immediate. After waiting a quarter of an hour, we may proceed with the estimation of phosphoric acid, only the filtration takes a little longer; after an hour the result is perfect.

As M. Boussingault has remarked, an excess of citrate of ammonia holds in solution very appreciable quantities of ammonio-magnesian phosphate; the loss, however, which results from it is very slight. For 0·050 grm. of phosphoric acid, and after waiting eighteen hours, not less than 6·852 grms. of citric acid were required to retain in the solution 0·002 grm. of the phosphoric acid. When the quantity of citric acid employed is from 80 to 100 times that of the phosphoric acid, there is no loss. One can judge by these examples, in which the proportion of magnesia is fixed at 0·060 grm. :—

	PO$_5$ Recovered in Presence of				
	Grm.	Grm.	Grm.	Grm.	Grm.
Citric acid ..	1·7130	2·5600	3·4260	5·1390	6·8520
No. 1	0·0502	0·0500	0·0502	0·0492	0·0484
No. 2	0·0500	0·0500	0·0598	0·0492	0·0482
Average	0·0501	0·0500	0·0500	0·0492	0·0483

PO$_5$ employed, 0·050.

On the contrary, the presence of lime completely changed the amplitude of the results.

Citrate of lime dissolves nearly three times more ammonio-magnesian phosphate than citrate of ammonia. The intervention of 0·059 grm. of lime has sufficed, in fact, to raise the loss of phosphoric acid from 0·002 grm. to 0·006 grm.; but I have ascertained that an excess of chloride of magnesium, so efficacious in hastening the precipitation of the ammonio-magnesian phosphate, completely neutralises the solvent action of the citrates of lime and ammonia, and confers on the results both accuracy and concordance.

Having arrived at this point, I have studied the pre-

cipitation of phosphoric acid in the presence of lime and aluminium, separately at first, then associated with lime; and I have arrived at this conclusion, that by keeping the quantities of citric acid, of chloride of magnesium, and of ammonia, and of the total volume of the liquid, between certain limits which I point out, the process is of irreproachable accuracy.

This may be judged of by a few examples, in which the modifying causes have been pushed to extremity. For instance, to 0·050 grm. of phosphoric acid I have added—Lime, 0·112 grm.; aluminium, 0·088 grm.; peroxide of iron, 0·120 grm.; total, six times the weight of phosphoric acid.

	PO5 Recovered.		
	After waiting eighteen hours.	After half an hour.	After quarter of an hour.
	Grm.	Grm.	Grm.
No. 1	0·0502	0·0500	0·0496
No. 2	0·0498	0·0500	0·0500
Average	0·0500	0·0500	0·0498

PO5 employed, 0·050 grm.

Therefore, whether we are working with natural phosphates or with commercial superphosphates; whether the product contains sulphuric acid, or is free from it; whether the proportion of alumina, oxide of iron, and lime is great or small; the indications of the process are always exact and concordant.

The method possesses the two characteristics of accuracy and swiftness, and a degree of generality which render it applicable in every case which may interest physiology, industry, and agriculture.

But, if this combination of merits brings it into favour amongst chemists, it must not be forgotten that to acquire them has demanded the united efforts of Messrs. Warington, Brassier, Leconte, and Boussingault.

NOTES UPON ANIMAL CHARCOAL.
THE PRESENCE OF FERROUS SULPHIDE IN CHAR.

By ROBERT FRAZER SMITH, F.C.S.

(Continued from p. 171.)

Expt. 4.—14 grms. of anhydrous calcic sulphate, 6 grms. of reduced iron, and 3 of lampblack were intimately mixed together, and exposed to a full red heat in a crucible for an hour. After cooling, the mass was pulverised in a mortar, and afterwards boiled in a flask with strong acetic acid. The amount of H_2S evolved was very trifling; the residue, however, was completely decomposed by HCl. The reaction was not studied further, the object aimed at being to prove that iron is quite capable of appropriating the sulphur to itself in presence of an equivalent amount of calcium and a sufficiently elevated temperature.

Expt. 5.—Equivalent weights of calcium carbonate and ferrous sulphide were heated to the temperature requisite for revivifying ordinary char, but no portion of the sulphur was transferred to the calcium.

The evil effects arising from the presence of sulphides in char are in many houses never felt, and to chemists employed in such the subject may possess little interest. On the other hand, many English and foreign refineries have suffered much, especially since the unsparing use of sulphur dioxide has again become fashionable. The amount of sulphate in char, though it may exceed 1 per cent, can do no harm unless the temperature has been excessive in the kiln.

If the temperature has been too high, calcium monosulphide is produced in the first instance. This substance can do no *permanent* injury, unless iron is present to fix and perpetuate the sulphur. The sugar liquor dissolves the calcium sulphide, acquiring the well-known disagree-

able tinges probably due to some substance akin to the colouring matters of Croissant and Bretonnière. The effect at the time is sufficiently distressing and disastrous, but the charcoal is not anything the worse if proper care be at once exercised. If, however, iron be present in quite sufficient quantity to take up all the reduced sulphur, and if this over-heating should occur more than once or twice, then a "disease" has been introduced which is almost beyond cure. Fermentation, either natural or artificial, must be resorted to, and this is a remedy which is often not much better than the trouble itself. The acids produced or used attack and destroy, in spite of varnishing, the iron cisterns and tanks, and by introducing fresh quantities of iron into the char, while at the moment removing the sulphides, simply spread a net for the gathering of a fresh supply.

I felt interested to know whether ferrous sulphide would be decomposed by lactic acid, the representative acid of sour sugar liquors.

Expt. 6.—Syrupy lactic acid and anhydrous ferrous sulphide were heated together. The latter was completely decomposed with the usual evolution of gas.

Expt. 7.—Sour "sweet water" was poured upon finely-divided ferrous sulphide in a flask. This was corked with a piece of "lead-paper" inserted in the neck. After a few hours, the paper was tinged, and the brown liquor, after filtration, when boiled, and the gas passed through lead acetate, yielded a grey-coloured precipitate.

Expt. 8.—A portion of the product from Expt. 1 was boiled with sour raw liquor. The greater portion of the sulphur was evolved as H_2S. The expulsion of ferrous sulphide by the organic acids of sugar liquors is slow and difficult, as compared with the calcium compound.

Expt. 9.—A sample of char received from an English refinery, and containing—

Calcic sulphate   = 0·619 per cent.
Ferrous sulphide = 0·407   ,,

was placed in a tube, and raw sugar-liquor of 23° B., containing 1 per cent of lactic acid was slowly passed through; the char being finally thoroughly washed with distilled water at 170° F., dried, and burned in the usual way. After this treatment, the—

Calcic sulphate was found = 0·601 per cent.
Ferrous sulphide   ,,   = 0·350   ,,

With decidedly acid sweet waters the sulphides are partly decomposed, though not to the extent often imagined. When no acidity is allowed to develop, the sulphides are sure to accumulate, especially when the chemist in charge is too lazy, as has happened now and then, to work out the causes of such accumulation and to point out the only cure. Of course, in Greenock such a state of affairs could not possibly exist, as our refiners look well to their own interests, and employ chemists in their laboratories who are "diligent in business."

The method used for estimating acidity in raw dark-coloured sugar-liquors by means of standard acid and litmus-paper is quite unreliable, as the alkaline salts of organic acids are alkaline to test-paper. A better way is to weigh out 5 grms. of powdered freshly-heated marble, and boil gently for a few minutes in a flask with an inverted condenser until gas ceases to come off. Wash the marble by decantation, dry, ignite gently, and weigh. 40 parts of calcium = 89 of lactic acid.

Expt. 10.—Sample of char, containing—

Sulphates   = 0·659 per cent,
Ferrous sulphide = 0·360   ,,

was boiled with water for four hours, collected, and washed with boiling-water. Dried perfectly, showed—

Sulphates   = 0·503 per cent.
Ferrous sulphide = 0·377   ,,

The sulphide is unaltered, but the sulphates are perceptibly diminished.

Expt. 11.—Another sample of the same was washed with

boiling-water until the washings ceased to react with baric sulphate, dried, and—

Sulphates   = 0·630 per cent.
Ferrous sulphide = 0·382   ,,

Expt. 12.—The char from last experiment was treated with its proper proportion of neutral raw liquor, then washed with hot water.

Sulphates   = 0·568 per cent.
Ferrous sulphide = 0·407   ,,

The method still frequently used, of estimating the sulphur in char by means of fuming nitric acid, is neither so accurate or so elegant as the potassium nitrate process. 5 grms. of finely-powdered char are mixed well with 5 to 10 grms. of a mixture of equal parts of absolutely sulphur-free potassium nitrate and carbonate. After heating in the muffle for half-an-hour, the semi-fused mass is washed into a beaker with boiling-water, HCl added in slight excess, and the solution vigorously boiled for some time. It is then filtered and treated with baric chloride in the usual way.

A minute amount of sulphur exists along with the carbon in organic combination; in an old char, one estimation gave 0·02 per cent.

As the iron is so closely connected with the sulphur, a very old char was taken, and divided into various sizes, to ascertain whether in this case, also, the iron was uniformly distributed through the bulk.

12 to 16	.. ..	0·92 per cent ferric oxide.	
16 ,, 24	.. ..	0·99 ,,	,,
24 ,, 30	.. ..	0·91 ,,	,,
30 ,, 40	.. ..	0·98 ,,	,,
40 ,, 50	.. ..	1·06 ,,	,,
50 ,, 60	.. ..	1·09 ,,	,,
Impalpable dust	1·32	,,	,,

The average amount of iron in twenty-five samples of working stocks from all parts of the kingdom was 0·75 Fe_2O_3.

(To be continued).

ON ANTHRACEN AND ALIZARINE.*

By FREDERICK VERSMANN, Ph.D.,

(Continued from page 182.)

ANTHRACEN having become of such great commercial importance, its most exhaustive scientific examination became a matter of course; and the last few years have brought us, especially from Germany, a number of most valuable investigations on nearly all the solid hydro-carbons. Berthelot had previously separated and described many of them, but perhaps he had not sufficiently large or sufficiently pure quantities to work upon; at all events more recent publications, the results chiefly of Graebe's and Liebermann's researches, have somewhat modified several of Berthelot's conclusions. In the following table I have given a list of these solid hydrocarbons, their formulæ, melting-point, and boiling-point, as far as they are known at present :—

SOLID HYDROCARBONS.

Name.	Formula.	Melting Point. Deg. C.	Boiling Point. Deg. C.
Naphthalene	$C_{10}H_8$	79	220
Acenaphthene	$C_{12}H_{10}$	100	285
Fluorene	—	113	305
Phenanthren	$C_{14}H_{10}$	110	340
Anthracen	$C_{14}H_{10}$	213	360
Pyrene	$C_{16}H_{10}$	180	—
Chrysene	$C_{18}H_{12}$	248	360
Retene	$C_{18}H_{18}$	95	400
Benzerythrene	—	—	—

Variable quantities of all these compounds are found in commercial anthracen, and their complete separation

* Read before the Society of Arts, Chemical Section.

becomes extremely difficult. In treating the commercial article it will always be best to remove the oil as completely as possible before attempting any further separation, and for this reason :—The oil itself is almost the best solvent of all the solid hydrocarbons, including anthracen, which is shown by the fact that after the settlement of the crystalline deposits in the oil, a considerable quantity is often re-dissolved with a slight increase in temperature of the air; if therefore, a sample, containing much oil, is treated with a solvent, the combined actions of oil and such solvent removes considerably more anthracen than the solvent alone. This remark holds good with alcohol and bisulphide of carbon analyses; a soft sample containing much oil always shows a lower percentage than the same sample previously pressed and separated from the oil.

The attempt to give a separate and distinct account of the characteristics of these solid hydrocarbons would be useless for practical purposes, because, with the exception of the first and last, they are extremely similar to one another, and a quantitative separation becomes a matter of great difficulty. The difference in the action of alcohol, ether, bisulphide of carbon, benzol, petroleum, and other solvents in merely a matter of degree. Nitric acid and sulphuric acid, chlorine, and bromine, produce similar compounds of addition or substitution. A solution of picric acid, mixed with a solution of the hydrocarbons, forms a series of compounds varying in colour from yellow and light orange, to dark blood-red, but which are so little stable that even an excess of the solvent, alcohol for instance, separates the acid again. Even similar products of oxidation are obtained from most of them, at least as far as they have been studied. Naphthalene may pretty easily be separated; all solvents take it up most freely; the low melting- and boiling-point is very marked; even water-vapour carries it off, and it may thus be purified. It is formed during the manufacture of gas, and is partly carried off and held in suspension by the gas. With a fall in temperature it often solidifies in the gas-pipes, so as almost to choke them up, and thus often becomes a great nuisance to the gas manufacturer, especially as by its abstraction from the gas the illuminating power of the last is sensibly decreased.

Benzerythrene, the last substance on our list, is very little known, and has scarcely yet been studied. It is the very last product in distilling pitch, and may thus be separated without difficulty. It is of a resinous character, After nearly all the oil with the hydrocarbons has passed over, this last product appears in the form of a bright red powdery vapour. It soon loses its fine colour on exposure to light, and assumes a dull brown colour.

Another substance has been separated from crude anthracen by Graebe and Caro, which they have named *Acridine*, $C_{12}H_9N$, and which is therefore a base containing nitrogen. This is remarkable for its intensely irritating action upon the skin and mucous membrane. The least particle of the dust inhaled produces most violent sneezing. Although it is present only in very minute quantities, it often is the cause of great annoyance to the workmen.

I now return to that point of my diagram where the tar is separated into oil and pitch. Finding that the anthracen passes over just at the last moment of the distillation, it was natural to assume that more might be left behind which could be separated on continuing or renewing the distillation. Many suggestions have been made to carry out this idea of obtaining anthracen in such a manner, but without destroying the pitch or without coking it, and they all appear to have been made without being verified by practical experiment.

Professor Kopp, whose contributions to the history of anthracen I have already mentioned, was perhaps the first to propose to melt pitch in à suitable vessel and to carry off the anthracen vapours by introducing superheated steam or air. Now it is well known what will happen in either case; the least trace of water is the great trouble in distilling tar or pitch, because it makes the whole mass

froth up and run over into the condensing pipes, and this will surely happen on blowing superheated steam into the molten pitch. So also with introducing a current of air into the hot mass, which will result in another slight inconvenience—it is sure to set fire to the contents of the still and to cause an explosion. This Professor Kopp seems to have foreseen himself, because he recommends us to deprive the air of its oxygen by passing it through red-hot iron tubes filled with charcoal.

But the object of these operations is to save the pitch which shall remain sufficiently fluid to run out of the still at the end of the operation.

The late Professor Calvert, who most successfully pursued scientific investigation and its practical application, and who I believe was the first to speak of the very subject of my paper in this room, in one of his Cantor lectures, expressed his opinion in the following words at Manchester :—

"I am aware that it has been proposed to distil soft pitch so as to obtain the volatile products that are given off in coking, but the expense, difficulty, and danger of such operation are such that I doubt if they can be overcome so as to produce anthracen of comparative purity on a commercial scale."

These remarks, I think, must refer to Professor Kopp's suggestions, and in that respect they are no doubt most applicable.

The records of the Patent-Office bear witness to a good deal of activity in this direction. The first patent was taken out by Broenner and Gutzkow. The principal claim of this patent is the process of converting anthracen into alizarine, but they also claim the production of anthracen from pitch by the very process I have just described, viz., by passing steam into the still.

The next patent was taken out by Mr. Henry Fenner and myself, and we were the first to distinctly claim the production of anthracen from coal-tar pitch, either as a continuous process of the tar distillation, or a separate operation, but in all cases we continue the distillation to the complete coking of the pitch ; we also were the first to practically carry out this process, and to obtain thereby anthracen on a large scale. This patent, like every other patent which is worth anything, has been made the subject of a good deal of discussion. First, it was asserted that everybody had done exactly the same thing long before ; then it became quite evident the thing could not be done at all ; lastly, it might possibly be done, but to no purpose.

Looking at the difference in distilling tar and pitch, it will readily be understood that the result must be somewhat different ; in the first case the impurities are chiefly those hydrocarbons which pass over before the anthracen, and which have a lower melting-point, while in the second case the higher hydrocarbons form the principal impurities. At first a great dislike, not to say prejudice, was created against the anthracen made from pitch, and with apparent reason, very likely because the buyers did not recognise the difference in the impurities, which of course necessitated a different treatment in the purification, and consequently the consumers did not succeed to their satisfaction in converting it into anthrachinon. However, all these difficulties have gradually been overcome ; it has been satisfactorily demonstrated that this kind of anthracen, properly purified, is identical with that obtained from tar, that it can just as easily be converted into anthrachinon and alizarine, of both of which I have samples on the table, and the highly purified products of the Anthracen Company (Limited), who works our patent, is beginning to find universal favour with the intelligent alizarine makers.

The separation of anthracen from pitch is most important, because the yield is thereby greatly increased ; tar alone gives about a half per cent of pure anthracen, while tar and pitch give at least two per cent.

The crude anthracen obtained from pitch is treated somewhat similarly to the tar-anthracen. The oil is allowed to stand for some time, it is then filtered, pressed, hydraulic pressed, and treated with suitable solvents to remove

most of the impurities, and there is no difficulty whatever in thus obtaining an article containing 70 per cent and more of pure anthracen.

The residue in the retort is a valuable coke, which is free from sulphur and phosphorus, and nearly free from mineral substances, containing about 99 per cent of carbon, and having an intense heating power ; I need scarcely say it is vastly superior to the ordinary gas coke, which contains all the mineral impurities of the coal in a concentrated form. There are several other patents in reference to the manufacture and purification of anthracen—Clark, Lucas, Caspers, and others—which I need not further notice.

None of the natural pitch or bitumen deposits seems to yield anthracen. I have myself tried Val de Travers, Trinidad, and several other of these deposits, without getting any hydrocarbon of this series. We must at present, therefore, look to the coal tar as our only starting point.

The yield of anthracen depends somewhat upon the quality of coal, and certainly also upon the degree of heat to which the coal has been exposed in the gas manufacture. Thus it is generally assumed that Scotch coals yield little anthracen, while South Staffordshire coal is rich in anthracen.

Pure anthracen crystallises in rhomboidal plates, which melt at 213° C. to a clear colourless liquid ; it distils at about 360° C. Nearly pure anthracen may be obtained by melting a partially purified sample in a retort, and passing a strong current of air through it, when the anthracen is carried off, and may be collected in the shape of brilliant flakes, or it may also be purified by sublimation.

I have determined the solubility of pure anthracen in alcohol of different specific gravity, and also in some other solvents, and the result is as follows :—

			Per cent Anthracen at 15° C.				Per cent Anthracen at 15° C.	
			By volume.	By weight.			By volume.	By weight.
Alcohol	..	800	0·472	0·591	Ether		0·858	1·175
,,	..	825	0·424	0·574	Chloroform		2·587	1·736
,,	..	830	0·408	0·491	Bisulphide of Carbon	}	1·180	1·478
,,	..	835	0·397	0·475				
,,	..	840	0·387	0·460	Glacial Acetic Acid		0·472	0·444
,,	..	850	0·360	0·423	Benzol		1·470	1·661
					Petroleum		0·291	0·394

(To be continued.)

CORRESPONDENCE.

VALUATION OF PHOSPHATES.

To the Editor of the Chemical News.

SIR,—Referring to a "Gloucestershire Farmer's" letter, in CHEMICAL NEWS, vol. xxx., p. 164, your correspondent through a printer's error stated that superphosphate of lime at 3s. 6d. per unit is £7 10s. per ton ; it should be £17 10s. It, however, shows the absurdity of chemists appraising articles the market value of which they have no knowledge, and, from recent exposures, do not seem even able to analyse correctly.

If chemists wish to save their profession from being looked upon by the commercial world as worse than useless, they should decline to put themselves in the position of valuators, which is quite out of their province, and only makes them appear ridiculous in the sight of the commercial community.

I would also hint that analytical chemists should determine which is the best method for doing commercial analyses, and arrange that they all analyse by that method only, and not continue to pursue the absurd course they are now doing, viz., that of each analysing by his own pet process, in consequence of which the results sometimes vary as much as 10 per cent, showing, in the case of super-

phosphate of lime, a difference in money value of 35s. per ton, and clearly showing the absurdity of chemists doing their own work in a bungling, untrustworthy manner, and yet, in the face of all their errors, set themselves before the public as authorities on the value of products they cannot analyse correctly.

Purchasers of manures are, as a rule, well aware of the prices ruling, and competition is so keen as to prevent manufacturers attempting an overcharge. If a "Gloucestershire Farmer" does not already know, I may inform him that any manufacturer will be glad to supply him with superphosphate of lime at from 3s. 3d. to 3s. 6d. per unit. —I am, &c.,

A READER.

October 21, 1874.

FERROUS SULPHIDE IN CHARCOAL.

To the Editor of the Chemical News.

SIR,—I notice in the CHEMICAL NEWS, vol. xxx., p. 171, a communication entitled "Notes upon Animal Charcoal: the Presence of Ferrous Sulphide in Char," by Robert Frazer Smith, F.C.S.

With regard to this paper, allow me to say that the presence of ferrous sulphide in char was supposed by Dr. Wallace, of Glasgow, and myself, from certain analyses made by me about two years ago. I also, at a subsequent period, examined the deposit on the kiln pipes. Dr. Wallace also examined the deposit, on his attention being drawn to it by me, and the figures given by Mr. Robert Frazer Smith are nearly identical with those found by Dr. Wallace and myself.

The investigation of this point is therefore not new, but, on the contrary, has been freely discussed by myself with several chemists in this neighbourhood. Further, the whole of my results and information on the subject were communicated by me to Mr. Robert Frazer Smith himself about eight months ago, and I leave it to the readers of your journal to judge if it is at all courteous on his part to discuss this question, and publish the statements contained in his article (which were substantially the same as those given by me to him), without in the slightest degree acknowledging my connection with the matter.—I am, &c.,

R. SPEIR.

Dellingburn Sugar Refinery, Greenock,
October 22, 1874.

DOUBLE IODIDES AND CHLORIDES.

To the Editor of the Chemical News.

SIR,—In the last number of the *Journal of the Chemical Society* there is an abstract of a paper by Mr. Lea, on an interesting compound of silver chloride with mercuric iodide. A quite similar compound was obtained five or six years ago in the laboratory of University College, by adding a few drops of silver nitrate to neutral Nessler's solution. It may interest your readers to learn that a corresponding *copper* compound can be obtained by using cupric sulphate in place of silver nitrate; and that the changes of colour which the compound thus formed undergoes on being heated are as remarkable as those observed with its silver analogue.—I am, &c.,

TEMPLE ORME.

University College School, London, N.W.,
October 22, 1874.

CRYSTALLISATION OF PHOSPHORUS.

To the Editor of the Chemical News.

SIR,—In reply to Mr. Herman's letter (CHEMICAL NEWS, vol. xxx., p. 194), I beg to say that the hole in the tube is sufficiently large to admit the point of a needle, it being made up by a portion of the phosphorus, the oxidation of which in the meantime has caused the disappearance of some of the crystals.

The phosphorus was not under sufficient pressure to liquefy it, but, on the other hand, was under slightly reduced pressure, which caused the phosphorus to crystallise quickly.

I see no reason in my account for the following passage in his letter:—"The rapidity with which the crystals formed in a tube in which the pressure was sufficient to *burst* a hole during sealing." It sounds like an explosion.

Mr. Herman says:—"The growth of crystals in tubes that have not been *heated*, and in which a slight rarefaction has been caused by the absorption of the oxygen of the air originally contained, is so slow, that after months, and even years, they are scarcely visible to the unaided eye."

If Mr. Herman will "heat" the phosphorus, and spread it over the sides of the tube, he will find that it will not take "months or years," but only "weeks," to make "beautiful colourless crystals" from the phosphorus, which will be slightly red.

I have made a quantity of colourless crystals, since I wrote to the CHEMICAL NEWS, by placing in a test-tube a piece of phosphorus, "corking" it up, melting the phosphorus, and causing it to spread over the sides of the tube, placing it in a freezing mixture for about a day, then allowing it to stand about five weeks.

I sent the tubes on Monday last to a well-known mineralogist, who has promised to examine them for me.

I shall be glad of Mr. Herman's opinion of the originality of the above method. Should Mr. Herman think the tube with the hole in a "myth," if he will send you his address I will send it to him.—I am, &c.,

GEORGE WHEWELL.

POISON SYPHON.

To the Editor of the Chemical News.

SIR,—This poison syphon consists of two pieces of glass tube, AC and BD, of about ⅛-in. bore. These are held at a distance of about 1½ inches apart by the piece E. There is no communication through E. A piece of india-

rubber tube, provided with a pinchcock, connects B to A. It is filled with water, and the short end placed in the liquid we wish to decant, which will at once flow through when the pinchcock is opened, this latter also regulating

the rate of delivery. When it is desirous to remove a liquid without admixture with water, the syphon is first filled with water, and the pinchcock opened for an instant to allow about an inch of the water to flow from the long leg, a corresponding quantity of air rushing up the short one. The short leg is placed in the liquid, which is, of course, separated from the water in the syphon by the bubble of air; the pinchcock is opened till this bubble of air reaches c, when all the water has been driven out, and its place taken by the liquid. By the same means it may be rinsed out after use, and should be hung up by the loop of the pinchcock. The water will not flow from the open end of a tube of such small bore.—I am, &c.,

ROLAND H. RIDOUT.

Grammar School, Monmouth,
Oct. 20, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 11, September 14, 1874.

Prof. A. W. Hoffman announces that the discovery of his pupils, MM. Tiemann and Hartmann, who succeeded in producing vanillin from the cambium of the pine tree, has been made available in practice. The juice of a tree of average size yields vanillin of the value of about 100 francs, and the timber is not damaged by the operation.

New Conditions for the Production of the Electric Effluve, and its Influence upon Chemical Reactions. M. A. Boillot.—The author, in continuing his researches on the nature of ozone, and on the reactions produced by the electric effluve by means of the apparatus described in previous communications, has been led to operate under the following novel conditions:—Instead of forcing the gas to pass between tubes forming a very narrow annular cylindric space, traversed by the effluve, he wished to ascertain what would happen on experimenting with the same source of electricity in a much larger space. To this end he took a first tube of glass, 36 centimetres long and 1 m.m. in internal diameter, and filled it with graphite reduced to a fine powder. One of its ends was closed at the lamp, and to the other end was sealed a platinum wire communicating with the graphite. This small tube was placed in the centre of a tube of medium size, of 9 m.m. internal diameter, so that there was an interval of at least 3 m.m. between the sides of the two tubes in the entire length of the annular cylindric space which they formed. Into this space the gases were to penetrate, and there undergo the action of the effluve, being in contact merely with the sides of the tubes. The above combination of tubes was fixed in a third and larger tube of the same length as the former, the annular space being here also filled up with powdered graphite. The two rings of carbon at the ends of the large (outer) tube were then stoppered with shellac, a platinum wire being fixed in one of the rings so as to communicate with the carbon in the large tube at the opposite end to the platinum wire in the inner tube. From this latter side the gas enters into the space left between the small and the medium tube, which is prolonged at the other end, and re-curved over the trough where the gas has collected which has undergone the action of the electricity. This electricity is produced by connecting the platinum wires of the apparatus with the electrodes of an induction coil working with two, three, four, or five moderate sized Bunsen elements. In these conditions, and under the action of so feeble an electric tension, the effluve acts

upon the gaseous current experimented upon. Both with atmospheric air and with oxygen ozone was produced in proportions not less than with the author's other apparatus.

Certain Tungstiferous Minerals from Meymac.—Ad. Carnot.—Three tungstiferous minerals are found at Meymac—wolfram, calcareous scheelite, and hydrous tungstic acid. Wolfram occurs in lamellar masses, brilliant, and of easy cleavage. Definite crystals have not been met with. It is less black and brilliant than the wolfram of Zinnwald (Bohemia), or that of the Puy-les-Vignes (Haute Vienne). Its powder is a light brown; it is not magnetic; its sp. gr. is 6·54. The fracture shows dull brown spots, irregularly distributed. Its composition is:—

Tungstic acid	72·67
Ferrous oxide	14·70
Manganous oxide	3·38
Lime	0·70
Magnesia	traces
Tantalic acid	0·90
Quartz, clay, &c.	4·00
Water	1·55
	100·00

Scheelite, or tungstate of lime, is found in masses of a crystalline texture, a vitreous—slightly adamantine—lustre, and a grey or brownish colour. Its fracture is lamellar, and occasionally iridescent. Its composition is—

Tungstic acid	74·20
Lime	18·84
Ferric oxide	1·51
Manganic oxide	0·35
Tantalic acid	0·40
Gangue (quartz)	4·24
	99·54

Hydrated tungstic acid takes in various places a yellow or greenish yellow, preserving its crystalline texture, and sensible cleavage. At other times its transformation is more complete, and the mineral is friable between the fingers of a distinctly yellow or brownish colour, and a resinous lustre. If gradually heated its colour deepens to an orange-brown, and finally it becomes almost black. It consists of—

Tungstic acid	71·85	74·25	75·12
Tantalic acid	1·00	1·05	0·70
Lime	2·50	4·65	7·00
Oxide of iron	6·00	6·10	6·25
Oxide of manganese ..	0·75	0·65	0·32
Water	12·93	11·75	6·85
Gangue	4·50	1·85	2·55
	99·53	100·30	98·79

Papers on the treatment of the phylloxera have been contributed by M. Balbiani, M. Mouillefer, M. Rommier, M. Maurice Girard, M. G. Beaume, and M. Cauvy. M. Dumas commented at some length upon the first of these reports.

Causes which Modify the "Setting" of Gypsum; New Cements with Bases of Gypsum and Lime.—M. Ed. Landrin.—The author finds that plaster sets most rapidly when it contains 20 per cent of water. Slowness of setting may be produced by means of an excess of water, or more conveniently by gum, glycerin, gelatin, powder of mallows, &c. Inert bodies, such as sand, sulphate of baryta, and oxide of iron, do not answer the same end. Gypsum containing 10 per cent of lime as carbonate gives very good results.

Action of Heat upon Phenylxylen.—M. P. Barbier. —The author gives an account of the preparation and properties of phenylxylen. Like its isomer, benzyltoluen, it yields anthracen, but the secondary products are different, consisting chiefly of a mixture of benzol and xylen volatile at 140° C.

Case of Decomposition of Chloral Hydrate.— M. Tanret.—Chloral hydrate is decomposed by permanganate in an alkaline solution, yielding carbonic oxide, carbonic acid, formic acid, and an alkaline chloride.

Development of Red Vapours during the Boiling of Saccharine Juices.—E. J. Maumené.—The author has observed an extraordinary evolution of red vapours at the moment when the air-pumps of the vacuum pans began to work, and at nearly all stages of the operation. There is generally a notable amount of nitrates in the juice of the beetroot. M. Maumené finds that sugar may be the cause, or one of the causes, of the formation of these red vapours. Whenever the juices contain nitrate of ammonia their decomposition is imminent. This is certainly one of the most active causes of discolouring the boiled mass, and of molassification in the last stage of the boiling process. The ammonia may be expelled by lime. The juice mixed with lime and water is considerably ameliorated if allowed to stand for twenty-four hours.

Synthesis of Purpurin.—M. F. de Lalande.—To 8 to 10 parts of concentrated sulphuric acid are added 1 part of alizarin dried and powdered, and 1 part of dried arsenic acid, or of peroxide of manganese. The temperature is gradually raised to 150° or 160° until a drop of the mixture, if thrown into water containing a little caustic soda, gives the colouration of purpurin. The mass is then thrown into a large quantity of water; the precipitate, exhausted with cold water, is then dissolved in a sufficient volume of a cold saturated solution of alum, and deposits on the addition of an acid abundant flakes of purpurin, which may be purified by a second solution in alum-water, followed by a crystallisation from superheated water.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 12, July 27, 1874.

Galvanic Conductive Power of Fused Salts.— F. Braun.—The numbers showing the conductive power of fused salts follow the same order in magnitude as those for saline solutions. Taking mercury = 100 millions, and sulphuric acid = 7700, the numbers lie between 32,000 ($PbCl_2$) and 88 ($ZnCl_2$). A connection between the galvanic conductibility and other physical properties (such as cohesion, melting-point, specific gravity, toughness), or chemical properties (such as molecular weight, molecular volume, quantivalence of the metal of the salts, or heat of decomposition) could not be recognised.

On Tertiary Nitrobutan.—J. Tschermak.—Nitrobutan, treated in the usual manner, yields neither a bromine derivative nor a nitrolic acid.

Action of Nitrous Acid upon Dimethylanilin and on Nitrosophenol.—Adolph Baeyer and H. Caro.— Nitrosophenol is converted into iso-nitrophenol by oxidation, and into amidophenol by reduction.

Synthesis of Anthrachinon Derivatives from Benzol Derivatives and Phthalic Acid.—A. Baeyer and H. Caro. —In this paper are described the mutual action of phthalic acid and phenol, oxy-anthrachinon, and erythroxy-anthrachinon. The characteristic reaction of these two bodies are tabulated in parallel columns. The authors further describe the action of phthalic acid upon pyrocatechin, upon hydrochinon, and upon other benzol derivatives.

Relations Between the Chemical Action of the Solar Spectrum, Absorption, and Anomalous Dispersion.—Hermann Vogel.—Further remarkable results have been obtained in pursuing the investigations described in *Berichte,* vi., p. 1302, and vii., 545. Here belongs the quantity of the colouring matter added to the bromide of silver. It might seem that much colour would have a great effect, but this is not the case, and sometimes the very reverse is observed. This is especially the case with naphthalin red, picrate of methyl-rosaniline, and aldehyd green. This phenomenon is parallel with the anomalous dispersion described by Kundt (*Pogg. Ann.,*

142, p. 163; 143, p. 259; and 144, p. 128). The elevation of the index of refraction corresponds to an elevation of sensibility, and its diminution to a decrease of sensibility, so that the chemical action of light appears to depend on the velocity of light in the excited media.

Peroxide of Hydrogen as a Cosmetic.—A. von Schrötter.—A description of a lotion for giving a gold colour to the hair.

Derivatives of Benzyl-Toluol, and of the Tolyl-Phenyl-Ketons.—H. Plaskuda and Th. Zincke.

α- and β-Benzoyl-Benzoic Acid.—H. Plaskuda.— These two papers are not suited for abstraction.

On Ultramarine.—E. Büchner.—The author proves experimentally that silica is absolutely essential for the formation of ultramarine. The decomposition of ultramarine by concentrated hydrochloric acid is not complete, and undecomposed particles can, in most cases, be detected with the microscope in the residue. Complete decomposition is only obtained by repeated treatment with concentrated sulphuric acid. Permanganate of potash is the best agent for oxidising the sulphur. He concludes that natural ultramarine has been formed from natrolite, acted upon by vapour of sulphur. He considers that Scheffer's red and yellow ultramarine (*Berichte,* v., 19) are products of the decomposition of ultramarine at an elevated temperature. He disputes the view of Dr. R. Hoffmann, who asserts that he has obtained crystalline ultramarine, and he shows that crystals of the very form described by Hoffmann occur both in the clay employed and in the residue from the decomposition of ultramarine by acids.

Preparation of Hypo-Phosphorous Acid.—Julius Thomsen.—285 grms. of pure hypo-phosphite of baryta were dissolved in 5 litres of water, and mixed with 98 grms. sulphuric acid, previously diluted with three to four times its weight of water. The liquid is well stirred, and let stand till the next day that the sulphate of baryta may settle. The clear liquid is then drawn off with a syphon, and evaporated down at a boiling heat in a porcelain capsule. When the liquid is reduced to one-tenth of its original bulk it is transferred to a platinum capsule, and a thermometer is suspended in the liquid (not touching the bottom) to regulate the temperature. The heat is kept first at about 105° C. A trace of a foreign body generally separates. The liquid is then filtered hot through washed paper, and returned to the platinum dish without being allowed to boil. After being heated for a quarter of an hour to 110°, the temperature is gradually raised to 130°, still avoiding ebullition. When it has been kept at this heat for about ten minutes the flame is withdrawn, the liquid cooled, and poured into a stoppered glass bottle.

Evolution of Heat in the Formation of Phosphorous Acid, Ortho-Phosphoric Acid, and Hypo-Phosphorous Acid from their Elements.—Julius Thomsen.

Evolution of Heat during the Formation of Arsenic and Arsenious Acids from their Elements Julius Thomsen.—These two papers cannot be usefully abridged.

Ortho-Cresol, and certain other Bodies of the Ortho Series.—A. Kekulé.—From otho-toluydin it is easy to obtain an iodo-toluol, which boils at 205° to 205·5° (211° if the whole column of mercury is immersed in the vapour).

Nitrophenol and Dioxybenzol.—H. Salkowski.—Not adapted for abstraction.

Identity of Walter's Moringic Acid with Oleic Acid.—K. Zaleski.—The so-called moringaic acid appears to be merely an impure oleic acid. The author remarks that in certain cases ultimate analysis fails to throw a satisfactory light on the composition of bodies without their derivatives and products of decomposition are studied.

Constitution of Phenyl-Bromethyl.—E. Bandrowski.—A hypothetical paper.

Explanation.—H. List.—A note bearing on the peucedanin controversy (No. x., p. 901).

Reply.—W. Weith.

Remarks on the above Reply.—A. W. Hofmann.—A continuation of the controversy on the desulphurisation of phenyl-mustard oil (See *Berichte*, vii., 523 and 814).

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Gazzetta Chimica Italiana, Anno iv., Fascicolo 5, 1874.

Extraction of Sulphur.—F. Sestini.—If sulphur and gypsum, both finely pounded, are mixed and heated in a long test-tube in the oil-bath, when the temperature reaches to between 115° to 120° the sulphur melts, and the gypsum floats upon its surface. If the temperature is maintained for an hour within these limits, nothing further ensues beyond the occasional escape of a bubble of watery vapour, which condenses on the sides of the tube. But if the temperature is raised beyond 130°, the production of watery vapour is increased to such an extent as to form a kind of effervescence, whilst a faint odour of sulphuretted hydrogen accompanies the vapour. If the temperature is carried up to 165° the liberation of steam soon decreases as the liquid sulphur becomes viscid, and hinders the vapour from escaping freely. If sulphur and gypsum are heated in a covered crucible to 450° anhydrous sulphuric acid is formed, and sulphide of calcium remains. Thus, at 130°, the gypsum loses water and becomes anhydrous, whilst at higher temperatures the sulphur takes oxygen from the sulphate of lime. These phenomena have a practical bearing upon the extraction of sulphur by distillation, since the minerals often contain sulphur.

Action of Sulphur upon Earthy Carbonates, especially upon Neutral Carbonate of Lime.—Prof. Egidio Polacci.—In a former paper the author has shown that a mixture of sulphur and carbonate of lime, moistened with water and exposed to the air, becomes converted into sulphate of lime. He has now satisfied himself, by many experiments, that in certain natural circumstances sulphur may, by itself, combine with atmospheric oxygen so as to produce sulphuric acid. Besides carbonate of lime, other earthy carbonates may become converted into sulphates in contact with sulphur. He considers that if gypsum meets with carbonate of potash, soda, or lithia in the soil there is production of sulphates of potash, soda, or lithia, and of carbonate of lime: carbonate of ammonia decomposes it, and fixes ammonia by forming sulphate of ammonia and carbonate of lime. Gypsum converts into sulphates all the soluble alkaline carbonates, which is probably the origin of the alkaline sulphates met with in natural soils.

Chemical Researches on Turkey Red.—Professor Abelardo Romegialli.—This paper does not admit of abstraction.

Reports from the Œnological Station of Asti.—The report consists of papers on the quantitative determination of œnocyanin, by E. Grassi; experiments on the fermentation of must; an experiment on alcoholic fermentation; reply to a letter of Signor Negri, all by the same author; and a new method of determining glucose and tannin in wines and musts, by I. Macagno.

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Reimann's Farber Zeitung, No. 37, 1874.

This number contains the commencement of a paper on dyeing ombrés and double ombrés; a continuation of the article on dyeing felt hats; Schlumberger's code of instructions for printing upon woollens, silks, and calicoes with his coal-tar colours; receipts for dyeing a brown and a Bismarck on silk goods with cotton warps; for a chamois, a dark brown, a black, a drap, and a bright fast pansy on wool; a brown on woollen yarn; a prussian blue on woollen cloth; a dark blue on " beiderwand"; and for printing a bright fast brown on cotton yarns and calico.

Meister Lucius, and Brüning's patent for the production of artificial alizarin is as follows:—Heat purified anthracen—melting-point 207° to 210°—in pans of earthenware or enamelled iron along with one-fourth its weight chromate of potash, and twelve times its weight nitric acid of the sp. gr. 1·05 for three hours. Dissolve the crude anthrachinon in 6 parts of boiling nitric acid, of sp. gr. 1·5. The solution is complete when no anthrachinon separates out on cooling. From this solution mono-nitro-anthrachinon is precipitated as a yellow deposit on adding water, and is washed, dried, mixed with 9 to 12 parts of solution of hydrate of soda, of the sp. gr. 1·4, and heated to 170° to 220°, until a portion withdrawn is found to give no additional precipitate when mixed with hydrochloric acid. The mass is then allowed to cool, dissolved in boiling water, filtered, and mixed with an acid which causes the colouring matter to be deposited as a yellowish brown sediment.

PATENTS.

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ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the preservation of meat or animal substances. John Garrett Tongue, of the firm of Tongue and Birkbeck, patent agents and engineers, 34, Southampton Buildings, Chancery Lane, Middlesex. (A communication from Julius August Heinrich Damkoehler, Berlin.) February 9, 1874.—No. 505. This invention consists in first drying the meat at a temperature of about 35° to 60° R. until a thin coating or crust is formed all over it. It is then packed in cases containing hard dry salt, in which the meat is entirely imbedded.

Improvements in obtaining a white pigment, and in the process employed therefor. John Bryson Orr, manufacturing chemist, Glasgow, Lanark, N.B. February 10, 1874.—No. 517. The features of novelty which constitute this invention are—First. The production of a compound or combination of barium sulphate and zinc sulphide. Second. The chilling of the said compound or combination so as to increase its density, and impart body thereto.

Improvements in the manufacture and production of common salt, and in the apparatus employed therein. Frederick Bale, Government science teacher, Coventry Hospital, Droitwich, Worcestershire. February 10, 1874.—No. 521. This invention has for its object improvements in the manufacture and production of common salt, whereby a great saving in time and expense will be secured. This is accomplished by bringing the salt-cake and alkali manufacture into the common salt-making districts, and passing the hydrochloric acid evolved into the brine, and thus precipitating the sodic chloride or common salt.

Improvements in the manufacture of building materials and other similar products. Joseph Deléon, Boulevard de Strasbourg, Paris. February 10, 1874.—No. 525. This consists in producing imitation stone, marble, brick, as well as tiles and ceramic blocks of all kinds, by a composition of powdered limestone and sand with magnesia, chloride of magnesium, and carbonate of soda. These being all well mixed are moulded into the form desired, when the three last-named ingredients react chemically, and the whole mass becomes firmly aggregated.

Improvements in the manufacture of size. Thomas Blackburn, manufacturing chemist, Mellor, near Blackburn, Lancaster. February 12, 1874.—No. 540. My invention consists in combining chloride of zinc, or any other suitable salt of zinc, or salts of alumina or magnesia, caustic potash, sulphite of soda, or potash and water, either with or without farinaceous matter, or china clay, or soap-stone, or gum, or glue, or other adhesive substances.

Improvements in precipitating metallic copper from its solutions, and in obtaining a utilisable material from the agent employed for the purpose. John Thomson Duncan, accountant, Glasgow, Lanark, Scotland. (A communication from Thomas Sterry Hunt, Boston, Mass., U.S.A.) February 12, 1874.—No. 546. Tin-plate, scrap, or waste is used for precipitating copper from its solutions, and the adhering tin is saved. The copper solutions contain protochloride of copper, and a sulphate of soda or other base. The tin is recovered by its solution and precipitation as an oxide.

Improvements in the production of artificial fuel. Lieut.-Colonel Alexander Frederic Corbett, Doncaster, York. February 14, 1874.—No. 568.—The fuel is composed of 5 lbs. by weight of powdered charcoal, 6 lbs. clay or clayey earth, and 1 gallon of liquor, into which 6 or 7 lbs., dried cattle dung or peat have been stirred. These ingredients are added and mixed separately, and formed into a stiff paste mortarlike, and shaped by hand, or moulded, and dried.

Improvements in purifying alcohol, and in the apparatus employed therein. Comte de Beaurepaire de Louvagny, Boulevard de Strasbourg, Paris. February 17, 1874.—No. 591. This consists chiefly in purifying alcohol, while being distilled, of its etherous impurities by making use of the fact that ether volatilises at a lower temperature than alcohol. Air is pumped into a boiler containing the alcohol to be purified, raised to such a heat that the ether is volatile while the alcohol remains fixed, and the air bubbling through the liquid carries off the ether.

Improvements in the production of salicylic acid, and of the isomeric and homologous acids. John Henry Johnson, Lincoln's Inn Fields, Middlesex. (A communication from Prof. Hermann Kolbe, Leipzig, Saxony.) February 17, 1874.—No. 595. The essential features of this invention consist in the production of salicylic acid, and of other acids of the aromatic series, by the action of carbonic acid gas on carbolic acid, cresolic acids, or a mixture of them, in presence of alkalies or alkaline earths, or a mixture of them.

NOTES AND QUERIES.

Extracts of Indigo.—Could any of the contributors to your valuable paper give the readers of the CHEMICAL NEWS an article on the manufacture of extracts of indigo, as it is becoming an important article of manufacture in West Yorkshire? Works for its manufacture are increasing yearly.—F. GREEN.

Aniline Black.—Can you kindly inform me, through the medium of the CHEMICAL NEWS, of the simplest method of producing a *soluble* aniline black, to use for a writing ink? I have made nearly every other colour, but cannot succeed in getting a good black, the nearest approach being a dirty brown. I have made a green paste which turns blackish with NH_4HO, by treating aniline with $HCl + MnO_2$, but it will not dissolve in alcohol. Its best solvent (HCl) makes a green solution. —A. PERCY SMITH.

Arsenic Fluoride.—In reading Mr. Macivor's paper, " On Arsenic Fluoride," there is one point I cannot understand. How is it that in the reaction water is produced in the exact quantity to convert the AsF_3 into As_2O_3 and $6HF$, and yet under these circumstances AsF_3 distils over, seeing that in the next sentence he says " water immediately decomposes it." I have tried to make it according to his formulæ, and with an excess of sulphuric acid, but I have failed in obtaining AsF_3. Would Mr. Macivor kindly explain the above?—N. T. JONES.

Elastic Composition.—Can you kindly assist me by telling, through your journal, how to render glue or gelatin permanently elastic, *i.e.*, not to shrink and get dry on the outside. I have heard it can be done by addition of glycerin, but, though I have tried several proportions, have not yet been successful; or that it can be attained by immersing the article in some chemical substance. Glue and treacle answers well for common dark work, but I want to make some much lighter. Or, if there is no means of using gelatin, &c., if you could give me a hint of the composition of the enclosed, or refer me to a work that I could find it in, you would much oblige me.—E. M.

MEETINGS FOR THE WEEK.

MONDAY, Nov. 2nd.—Royal Institution, 2. General Monthly Meeting.
THURSDAY, 5th.—Chemical, 8. Dr. C. Schorlemmer, "On Methyl-Hexyl Carbinol." Dr. C. R. A. Wright, "On the Action of Organic Acids and their Anhydrides on the Natural Alkaloids." Dr. J. L. W. Thudichum, "Further Researches on Bilirubin and its Compounds." Dr. Stenhouse, "Action of Bromine in the Presence of Water on Bromo-Pyrogallol and on Bromo-Pyrocatechin."

TO CORRESPONDENTS.

J. W. Mallet.—Received with thanks; it shall appear in an early number.
A Subscriber.—Wagner's " Chemical Technology," published by J. and A. Churchill.

THE CHEMICAL NEWS.

VOL. XXX. No. 780.

ANALYSIS OF BUFFALO BONES
AS COLLECTED FROM THE GREAT PLAINS OF AMERICA.
By J. W. MALLET,
Professor of Chemistry, University of Virginia.

AMONGST the materials coming into commercial use for the manufacture of phosphatic manures are the dry and partially bleached bones of the buffalo (bison), annually killed in great numbers upon the plains of the interior of the American Continent, both by Indians and white men, many of these bones having, doubtless, lain exposed to the weather for very long periods of time.

A few months ago a sample fell into my hands of this material in a ground state, the fragments ranging from the size of a pea downwards. A carefully conducted analysis afforded the following results, which may be worth recording, as a little addition to our knowledge of bone as affected by exposure to the atmosphere. It will be seen that the amount of nitrogenous organic matter remaining is quite large, notwithstanding the brittle condition of most of the bone.

	As Received.	Dried at 105° C. Calc. for 100 parts.
Fat (dissolved out by ether) ..	0·721	0·788
Partially-altered osseine,* &c...	28·697	31·379
Calcium phosphate (tribasic) ..	49·437	54·058
Magnesium phosphate (tribasic)	2·307	2·523
Calcium fluoride..	0·438	0·479
Calcium chloride (calc. from Cl insol. in water)	0·124	0·136
Calcium carbonate (CO₂ directly determined)..	7·545	8·250
Calcium monoxide (Ca in excess of above-mentioned forms)	0·715	0·782
Sodium chloride..	0·114	0·125
Potassium (chloride ?)	trace	trace
Sodium sulphate..	trace	trace
Iron sesquioxide..	0·096	0·105
Manganese	trace	trace
Insoluble (siliceous) residue ..	1·258	1·375
Water† (driven off at 105° C.) ..	8·272	—
	99·724	100·000

* Containing nitrogen—Bone as received, 3·971 ; dried at 105°, 4·342.
† Thermometer = 29° C., barometer = 746 m.m., when bone was weighed off for analysis.

University of Virginia,
Oct. 10, 1874.

ON THE DETERMINATION OF SULPHUR IN COAL AND COKE.
By W. F. K. STOCK, F.C.S.

IT is proposed by Eschka (*Chem. Centr.*, 1874, 301) to determine sulphur in coal or coke by the combustion of the fuel by atmospheric oxygen, in contact with mixed sodium carbonate and magnesium oxide in a platinum crucible, and to secure the conversion of any other oxygen or sulphur compounds into sulphates by subsequent ignition with ammonium nitrate.

For three months prior to Eschka's communication, I had been endeavouring to devise a more satisfactory method than any of those in general use, such as oxidation by fuming nitric acid, fusion with mixed alkaline nitrates and carbonates, or deflagration with potassium nitrate alone, but pressure of business prevented me from completing my experiments earlier. After many trials attended with indifferent success, I eventually adopted the following, as being a process combining simplicity with rapidity and uniform accuracy of results :—

One grm. of coal or coke in fine powder and 1 grm. of pure lime are mixed in a platinum capsule 9 c.m. in diameter, having perpendicular sides 1·3 c.m. in depth, and weighing about 30 grms.; distilled water is then added in sufficient quantity to form a thin paste of the consistency of cream, and the whole stirred with a short glass rod until the operator is sure that every particle of the fuel under examination is in perfect contact with the solution of calcium hydrate. The capsule is now heated upon a thick cast-iron plate by means of a Bunsen's burner, and as soon as the mass becomes dry, which is speedily accomplished, it is stirred into a coarse powder, and heated to bright redness in a muffle for about twenty minutes, at the end of which time the whole of the carbon will have undergone combustion. The capsule is allowed to cool, and 3 c.c. of a concentrated solution of ammonium nitrate are added. In making this addition, care must be taken not to allow the solution to mix too freely with the assay, otherwise loss of substance is sure to result from the energetic action of the calcium oxide upon the ammonium salt. It is best to scrape a portion of the lime from the bottom of the platinum vessel, and to drop the solution gradually upon the bare spot from a pipette. The mass is again brought to dryness and heated to redness for five minutes, then cooled, dissolved in dilute HCl, and the sulphur determined as $BaSO_4$ in the usual manner.

In order to test the value of this process, a sample of Durham coke, known to contain about 1·5 per cent of sulphur, was taken, and the sulphur carefully determined three times by the old process of deflagration with potassium nitrate, and three times by the new lime process, and the following results were obtained, respectively :—

		Deflagration with KNO_3.	Combustion with CaO.
1.	Sulphur =	1·450	1·440
2.	,, =	1·380	1·440
3.	,, =	1·510	1·450
	Mean =	1·446	1·443

I believe the minimum in the results from deflagration to be due to overheating, and the maximum to presence of undecomposed nitrate in the solution, and consequent contamination of the $BaSO_4$.

This short note would be incomplete without my acknowledgment of the aid I have received from my senior assistant, Mr. W. Edwin Jack, in the performance of the many analyses I have found necessary.

Analytical Laboratory, Darlington,
October 27, 1874.

THE DISAPPEARANCE OF ORGANIC MATTER IN WATER RUNNING THROUGH IRON PIPES.
By A. WYNTER BLYTH, M.R.C.S., A.K.C., &c.,
Analyst to the County of Devon, Medical Officer of Health, &c.

THE continuous oxidation of nitrogenous substances in ordinary running water freely exposed to air has been long known; but that organic matter disappears, and that water becomes purer, by simply running a certain distance in closed pipes, is, I believe, a fact not generally known, and of considerable importance to the sanitary engineer and hygienist.

Both the supplies given in the table are intermittent, and therefore it is possible that in places the pipes may be rusty, although I am assured that the glazed iron pipes used for water-mains do not rust; but, if they do, the puri

fication would be easily explained. The samples, both of the Barnstaple and Ilfracombe supply, were taken in the same day. At Barnstaple, first R was carefully collected; we then walked slowly down to A, half a mile from R; from thence to B, half a mile from A ; and from thence to C, half a mile from B. The last sample, C, shows a difference in total ammonia of 0·08 m.grm.; the nitrates are certainly not increased, rather the reverse. The Ilfracombe supply was sent to me by the urban sanitary authority, and was collected with great care in the same day. There is a remarkable difference between the same water before and after it courses through the iron mains.

Solid Residue.

	Organic and Volatile.	Fixed.	Total.	Ammonia, Free.	Ammonia, Albumenoid.	Nitrogen, as Nitrates, &c.	Chlorine.
	Milligrms. per litre.	Milligrms. per litre.	Milligrms. per litre.	Milligrms. per litre.	Milligrms. per litre.	Milligrms. per litre.	Milligrms. per litre.
(1). *Barnstaple supply—* R. Reservoir after passing through the filter-beds ..	40·0	60·0	100·0	0·060	0·090	2·30	16·14
A.	40·0	60·0	100·0	0·040	0·080	2·00	16·14
B.	40·0	60·0	100·0	0·035	0·075	2·00	16·14
C.	39·0	60·0	99·0	0·010	0·060	2·05	16·14
(2). *Ilfracombe supply—* A. Taken directly after passing the filter-beds..	70·0	140·0	210·0	0·060	0·140	Not estimated.	21·43
B.	10·0	140·0	150·0	0·020	0·060	,,	21·43

Barnstaple, October 22, 1874.

NOTE ON A SAMPLE OF GENUINE BLACK TEA.

By A. WYNTER BLYTH, M.R.C.S., A.K.C., &c.,
Analyst to the County of Devon, Medical Officer of Health, &c.

IT is well to accumulate evidence on genuine articles of food. In this short note I have nothing new to offer; its only value arises from the fact that the tea examined was grown upon my brother-in-law's (Dr. Shortt's) own plantation in India, and transmitted to me from Madras, so that all suspicion of adulteration is excluded. The assay confirms the analyses of Peligot, Wanklyn, and Allen, but the yield of ammonia from 100 m.grms. is rather higher than Mr. Wanklyn's average, who, I believe, puts it at 0·71 m.grm.

Genuine Indian Black Tea.

The Tea taken in its ordinary state. Per cent.

Extract	33·900
Ash { Soluble 2·863 / Insoluble 3·288 }	5·510
Tannin	11·500

Total ammonia yielded from 100 m.grms. of tea = 0·85 m.grms.

Barnstaple, October 30, 1874.

DETERMINATION OF AVAILABLE SULPHUR IN SPENT OXIDES.

By H. B. YARDLEY.

THE following process for this determination has, I understand, been introduced by some chemist (?):—

A weighed portion is placed in an apparatus similar to that used in determining oil in oil-cakes, &c., by means of ether, using bisulphide of carbon in place of the ether, the matters dissolved out by the reagent being weighed as sulphur.

With a view to testing the accuracy of the above process, I have made four or five trials of it on different samples, only one of which gave results anything near correctness, the figures then being—

By nitric acid oxidation, 38·44 per cent total sulphur.

          5·05   ,,   sulphur as SO_3.

          33·39   ,,   available sulphur.

By bisulphide of carbon 33·72 per cent sulphur.

This sample, however, appeared remarkably free from tarry impurities, though the extracted sulphur was here slightly discoloured. In another sample, the bisulphide process, distilling over twice, gave 2 per cent too much, and distilling only once, 4 per cent too low ; in each case the extracted *sulphur* being very dark-coloured, and when heated leaving a considerable carbonaceous residue, which was completely burnt on further heating in the blowpipe-flame. This was a very dark, strong-smelling sample.

From these data, it would appear that this process is perfectly unreliable. I have, however, found it extremely useful when, as often happens during oxidation with nitric acid, the sulphur is separated in small globules. The samples containing very often a quantity of organic matters, piece of sawdust, &c., not destroyed by the nitric acid, the weight of the globules cannot be determined by drying the insoluble residue, burning, and calculating the loss as sulphur. In these cases, the separated sulphur can be easily and quickly ascertained by extracting with the bisulphide, other matters soluble in the reagent having been destroyed during oxidation.

ON BENZO-NITROTOLUIDIDE, AND THE ACTION OF REDUCING AGENTS UPON IT.

By CHICHESTER A. BELL, M.B.

IN CHEMICAL NEWS, vol. xxix., p. 167, I described an attempt to produce, by the action of alcoholic ammonium sulphide on benzo-nitranilide, the oxygen-free base—

$$\left. \begin{matrix} C_6H_4'' \\ C_7H_5''' \\ H \end{matrix} \right\} N_2,$$
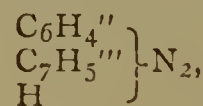
analogous to the compounds described by Hobrecker[*] under the titles ethenyl-diamido-toluol and ethenyl-diamido-xylol, obtained by the action of nascent hydrogen on acet-nitramido-toluol and acet-nitramido-xylol. The attempt was unsuccessful ; the nitranilide simply passed into a phenylen-diamine, the benzoic radical remaining unchanged.

In the hope of effecting reduction of the benzoyl group also, I have since submitted benzo-nitranilide to the action of nascent hydrogen developed from tin and moderately concentrated hydrochloric acid. On heating the mixture for some time, filtering while hot, and allowing to cool, handsome crystalline tufts of a double chloride were deposited. Through the diluted solution sulphuretted hydrogen was passed, so as completely to remove the tin, the filtrate concentrated, and treated with caustic potash. From the resinous precipitate thus obtained, the base was extracted by boiling-water and purified by repeated crystallisations. Its identity with that previously obtained (by the action of ammonium sulphide) was established by its fusing-point (125° C.), and by a platinum determination in its platinum double salt. Calculated for—

$$2\left(\begin{matrix} C_6H_4 \\ C_7H_5O \\ H_3 \end{matrix} \right\} N_2.HCl).PtCl_4 = 23·77 \text{ per cent.}$$
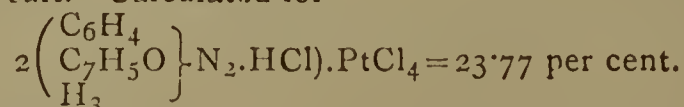
Found = 23·45.

Hobrecker, in his experiments on the fatty derivatives of the aromatic nitramides, was unable to reduce the acetyl

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[*] Hobrecker, *Ber. der Deutsch. Chem. Gesell.*, 1872, p. 920.

group in nitracetanilide, but succeeded in the case of nitraceto-toluidide. I have, therefore, formed a benzo-nitrotoluidide, and submitted it also to the action of nascent hydrogen. As I have been unable to find any description of this body, I give a brief account of its properties.

Benzo-nitrotoluidide is readily formed when benzoyl-chloride is allowed to act directly, at a gentle heat, upon nitro-toluidine (fusing-point, 77·5° C.). The reaction proceeds, however, much more smoothly when the two bodies are brought together in anhydrous ethereal solution. The amide is thus almost completely precipitated, whilst nitro-toluidine hydrochlorate remains in solution. After removal of the ether by evaporation, the latter compound must be extracted by boiling-water, and the residual benzo-nitro-toluidide purified by repeated crystallisations from boiling alcohol. It is thus obtained in delicate pale yellow prisms, which, on heating, transiently assume a deeper colour. It melts at 172° C., and by very cautious heating may be sublimed unaltered. It is insoluble in water, slightly soluble in cold alcohol, ether, and benzol, readily so in these liquids when boiling. Neither dilute acids in general, nor strong hydrochloric acid, will dissolve it. Cold sulphuric acid takes it up freely; from this solution it is deposited unaltered on dilution. Even prolonged boiling with strong soda-lye fails to decompose it to any extent; alcoholic potash and boiling concentrated acids readily act upon it. Analysis yielded the following results:—

	Theory.	Found.
C	65·62	65·50
H	4·69	4·91

The reduction was accomplished by tin and hydrochloric acid, exactly as in the case of benzo-nitranilide, and with precisely similar results. Any attempt to carry it farther, either by prolonged heating, or by using a highly concentrated acid, results in the formation of toluylen-diamine and free benzoic acid. Like its homologue, benzoyl-toluylen-diamine is very soluble in alcohol and ether; boiling-water takes it up sparingly, and deposits it on cooling in transparent colourless prisms which melt about 142° to 143° C. It is readily soluble in dilute acids; hot concentrated acids decompose it. Analysis gave the following results:—

	Theory.	Found.
C	74·33	73·89
H	6·19	6·53

Unfortunately, the quantity of substance at my disposal did not admit of its being obtained in a state of absolute purity.

Thus, in these two instances, the attempt to reduce the benzoyl group was unsuccessful. The failure might, perhaps, have been foreseen. In fact, the monatomic group (C_7H_5O) would, by reduction, become triatomic, $(C_7H_5)'''$, and in a phenylen- or toluylen-diamine must be directly connected with both atoms of nitrogen. Now, Hobrecker and Hübner and Retschy* have experimented with nitra-mides produced by the direct nitrification of the corresponding amides, and in these compounds it is generally admitted that the nitro and amido groups occupy contiguous positions in the molecule; whilst in para-nitraniline and para-nitrotoluidine, which I have employed, the two groups are widely separated. Hence, the existence of triatomic radicals would be possible in the diamines obtained by reduction of the former class of compounds, but impossible in those derived from the latter.

It is my intention to extend these experiments to derivatives of ortho-nitraniline, containing other radicals than those of the fatty and benzoic series.

Steevens's Hospital Laboratory, Dublin.

Glasgow Veterinary College.—Dr. R. Carter Moffat has been awarded a Gold Medal and Diploma by the Italian Government in recognition of the industrial investigations and discoveries made by him in Italy recently.

* Hübner and Retschy, *Ber. der Deutsch. Chem. Gesell.*, 1873, p. 798, 1128.

ON ANTHRACEN AND ALIZARINE.*

By FREDERICK VERSMANN, Ph.D.,

Having thus obtained the anthracen by one method or the other in a saleable form, we may next consider the method of determining its marketable value, and here I come to the most unsatisfactory part of the whole subject, a part which I am anxious to thoroughly ventilate.

In other commercial analyses the results obtained by the chemist, in almost all cases, is expressed in percentage of a definite, pure, chemical compound, from which, by simple calculation, the real and exact value of the merchandise is ascertained; no room is left for manipulating the analysis or for introducing modifications, by which the result is affected. This is unfortunately not the case with the anthracen tests. I have already drawn attention to the difficulty of the manufacturer has to contend with in separating the one hydrocarbon from the whole series, and if this is the case on the large scale, the difficulties no doubt increase with a laboratory experiment, and the chance of really trustworthy quantitative determination becomes almost hopeless. I repeat, the impurities which influence the value of the article are in all their physical properties so similar to anthracen itself, that it is impossible to effect a complete separation, either by solution, sublimation, or other mechanical means; nor do we know as yet of a convenient and entirely satisfactory process by which anthracen might be converted into a definite and distinct chemical compound, different from analogous products obtained from the impurities.

A short account of the usual anthracen tests will bear out my opinion. The first few parcels of anthracen were sold without any analysis whatever, and perhaps neither buyer nor seller knew what kind of bargain he had made, but soon the German alizarine makers looked up the tar distillers all over the country, and it became necessary to adopt some kind of test for determining the quality and value of this new product.

Dr. Gessert, of Elberfeld, in first introducing the alcohol test, was guided by the just opinion that the commercial value of a sample might be ascertained with sufficient accuracy by determining the percentage of hydrocarbon insoluble in alcohol, together with its melting and solidifying point. The details of the test are as follows:—

ALCOHOL TEST.

Take 20 grammes of the well-mixed sample, heat it in a beaker glass with 150 per cent of alcohol, sp. gr. 825, till it gently boils; then cool it to 15° C. (59° F.), bring it on a filter, and wash with so much alcohol that the filtrate measures 400 per cent. Dry the filter and residue in a water bath, detach the residue from the filter, and weigh; the weight multiplied by 5 gives the percentage. Mix the weighed residue well in a mortar, and introduce a small quantity into a narrow glass tube, about four inches long and one-sixteenth internal diameter, and drawn to a point at one end; fix the tube and a delicate thermometer into a small paraffin or ozokorite bath, which heat gently and gradually. Note the moment the anthracen becomes liquid, *i.e.*, when the first drop collects at the end of tube; this is the melting-point. Now increase the temperature to about 220° C., remove the flame, and note the moment the liquid becomes solid again, this is the solidifying-point, which with good samples should be nearly the same as the melting-point; the mean of the two is the final point.

Now, we know pure anthracen melts and solidifies at 213° C., and in order to make the test really accurate, the percentage of insoluble should be of such quality as to melt exactly at that temperature; but even then it might not be pure anthracen, because some of the impurities have a lower and others a higher melting-point, and a mixture of the two might melt at 213° C. This, however, is a question which need not be considered, because such

* Read before the Society of Arts, Chemical Section,

a mixture would show a wide difference in the melting and solidifying point, while with a pure, definite compound they should be very nearly the same. The determination of the melting-point altogether is an operation demanding great attention. First of all, a very delicate thermometer is required, and none should be used without previous comparison with a standard thermometer; very few instruments are so exact as not to require a correction, sometimes of several degrees, both in the rise and fall of the mercury. Then, again, the melting-point of these hydrocarbons, especially in small quantities, often varies in like manner as that of sulphur, consequent to a change in the condition they have assumed by previous melting, more or less strong heating, or more or less rapid cooling.

But, nevertheless, although the alcohol test cannot claim anything like analytical accuracy, it may form a guide in fixing the approximate value of the article, provided the details of the test always remain the same.

The true melting-point of 213° C. was never insisted upon, but its maximum was first fixed at 200° C. Competition soon lowered to 195° C., and ultimately to 190° C., at which it now stands, *i.e.*, the present alcohol test means the determination of per cent of insoluble in alcohol, having a melting point of at least 190° C.

Of course, everybody knows that is not pure anthracen; still the test might be sufficiently accurate for comparative experiment, if always carried out in the same manner.

But now mercantile speculation and cleverness steps in and suggests trifling modifications for its own benefit. Knowing that the less anhydrous the alcohol is, the less it will dissolve, or, in other words, the higher the percentage of insoluble will be, several ingenious people have their test made with alcohol of 830, 835, or sometimes even of 840 sp. gr.

Again, an impure sample may have a melting-point much below 190° C. Then the chemist is often expected to take, not the actual proportion of alcohol, but an indefinite quantity, sufficient to bring up the melting-point to 190° C.

In such cases the analyst is, of course, helpless; he has simply to follow the instructions he may receive, and any protest of his would perhaps have no other effect than the loss of a client.

The reason for using alcohol of half-a-dozen different specific gravities is obvious; the percentage of insoluble may thereby be increased or decreased. But such tricks and manipulations should not be tolerated; they throw doubt and confusion upon all transactions, and undermine the value of chemical analysis altogether.

Some time after the alcohol test had been adopted, the bisulphide of carbon test was introduced, which is as follows :—

"Bisulphide of Carbon Test.

Take 10 grammes of the well-mixed sample, place it in a wide mouth stoppered bottle, together with 30 c.c. of bisulphide of carbon, shake up well and allow to stand for one hour at a temperature of 15° C. (59° F.) ; then bring the mixture on a filter, wash with 30 c.c. more bisulphide of carbon, and gently press the filter so as to dry it as much as possible ; then dry completely in a water-bath, detach the residue from filter and weigh ; the weight multiplied by 10 gives the percentage. The melting and solidifying points are taken as above."

The principle of this test is so far the same as that of the alcohol test, viz., that the impurities are more soluble in the liquid than anthracen, and may thereby, partly at least, be removed. We find bisulphide of carbon much more active than alcohol, and on treating one and the same sample with both tests, alcohol invariably yields a higher percentage of insoluble with a lower melting-point, while bisulphide gives a lower percentage with a higher melting-point. There is no fixed relation between the two results. The product of the bisulphide test seldom has a melting-point below 200° C., while with alcohol very few samples indeed show so high a melting-point. The result of the bisulphide test is therefore much purer, and ought to fetch a higher price ; but as no definite rule can be adopted, the constant mixing up of the two tests is another source of confusion.

(*To be continued*).

NOTICES OF BOOKS.

Causeries Scientifiques. By HENRI DE PARVILLE. Paris : J. Rothschild.

THERE are obviously two methods of compiling an annual record of discoveries and inventions. The one, preferred in England, consists in stringing together a number of paragraphs *au naturel*, if we may use the expression, just as they are found in scientific journals and in the transactions of learned societies. The other, adopted in the work before us, takes the original bare announcements of facts as its text, and seeks to weave them into a connected discourse. If the former plan be the less troublesome, the latter certainly produces a more readable book.

Turning, as is natural for us, to the chemical portion of the work, we find that especial attention has been given to ferments in the widest sense of the word. The germs and cells, which, when introduced into the system occasion zymotic disease, and those which play a part both in the manufacture and in the subsequent decomposition of wines and beers, have lately attracted much of the attention of French chemists. The following passage is a good popular view of the action of putrescent organic matter in water :—

"How does organic matter become dangerous ? We must not believe that it constitutes, as is superficially said, a toxic element. The phenomenon is more complex. The organic matter in suspension or in solution creates in the water a peculiar medium, suitable for the development of exceedingly small beings of the genus Vibrio. It is no longer mere water—it is a world of microscopic animals and plants which are born, live, and increase with bewildering rapidity. The Infusoria find in the water calcareous, magnesian, and ammoniacal salts, and their maintainence is thus secure. Drink a drop of this liquid and you swallow millions of minute beings. But there are vibrios and vibrios. There are those which are capable of setting up putrefaction in our tissues. These are our enemies, often our mortal enemies. Let a water be placed in contact with organic remains capable of nourishing these malignant vibrios, and it at once becomes more dangerous than any poison."

The author points out that, according to the researches of the late Dr. Calvert, charcoal, lime, and permanganate of potash, contrary to the received opinion, facilitate putrefaction and actually promote the formation of animalculæ. Charcoal when used for the purification of polluted waters, undoubtedly absorbs into its pores offensive gases held in solution, as well as liquid colouring and flavouring matters. It can render such waters colourless and tasteless. But upon living animalculæ and their germs it is absolutely powerless. Nay, water containing a known amount of "albumenoid ammonia" when experimentally filtered over animal charcoal, has been found on analysis worse than before. Permanganate of potash may oxidise —in fact, burn up—dead organic matter suspended or dissolved in water ; but upon living organisms it is almost powerless. We have seen animalculæ remain in full life and apparent vigour for hours in water to which permanganate had been added in a large proportion. M. Davaine found that putrid blood after treatment with charcoal became more poisonous than before. It is possible that the gases dissolved in the liquid hinder the development of the Infusoria. The author considers carbolic, or better still cresylic acid, as the only agent which extirpates these animalcules. According to Woehler, alumina in the gelatinous state precipitates the dissolved animal matter

which serves as a pabulum for these minute animal and vegetable beings. The experiments of M. Davaine on the power of antiseptics to destroy the virus of carbuncle belong rather to medicine than to chemistry. Solution of iodine seems the most effectual remedy.

The author quotes the recent researches of M. Eug. Peligot, showing that common salt is not a fertiliser as it is generally considered; at least for the majority of plants. But though sodium compounds are not as a rule absorbed by vegetation, further experiments are needed before we can legitimately pronounce them useless. The many instances in which a dressing of common salt has produced beneficial effects seem to indicate that it may be indirectly useful by promoting the solution or the decomposition of other bodies.

Liquorice-root is recommended as means of rendering quinine, colocynth, aloes, and other bitter medicines inoffensive to the taste. Unfortunately there are some persons to whom the remedy would be worse than the disease.

Glycerine is recommended to prevent incrustations in steam-boilers. It not only dissolves a large amount of the calcareous salts present, but it causes the residue to be deposited in a form in which they are incapable of attaching themselves to the metal.

This volume is, in short, a pleasant, chatty fire-side companion, which imparts a large amount of useful knowledge in a lucid and popular manner.

CORRESPONDENCE.

GASEOUS VOLUMES AND SPECIFIC GRAVITIES.

To the Editor of the Chemical News.

SIR,—The author of the article (CHEMICAL NEWS, vol. xxx., p. 199) "On the True Relation between the Weights, Volumes, and Specific Gravities of the Component Elements, and those of the Compound, in Chemical Combinations," apparently makes no claim to being himself a chemist, for he says he sought for information "in works of reference and from reputed chemists." He is probably a mathematician, and, happy only in applying the deductive methods of his science, he is careless about that preliminary verification of his data which is an object of so much solicitude to the merely experimental philosopher. It is not surprising that strange discrepancies result from calculations in which the specific gravity (air=1) of oxygen gas is taken as 1·6. When the true number (1·105) is substituted for the erroneous one, all the alleged contradictions vanish. In another calculation, into which the erroneous value does not enter, a curious slip occurs. The statement asserting the *equality* of the volumes of the imaginary gases before and after combination, in the reaction $C + CO_2 = 2CO$, is thus transcribed into an equation for the calculation of the density of carbon vapour:—

$$\left\{ \frac{C}{x} + \frac{C+2O}{1\cdot529} \right\} : \left\{ \frac{2(C+O)}{0\cdot9706} \right\} = 1 : 2.$$

The fallacy here is about the same as making $1+1=1$, and the value of x, so found, is of course somewhat perplexing. When the equation is written in accordance with the statement that "1 volume of carbonic acid added to [combined with] 1 volume of carbon vapour formed 2 volumes of carbonic oxide," the solution gives $x=0\cdot414$, which figures represent the density of the hypothetical vapour of carbon, on the supposition that the molecular formula of the element in the state of gas is C. It appears strange that the author's results did not lead him to suspect some inaccuracy in his data, or in his deductions, instead of forcing him to the alternative conclusion that there must be some unrecognised fallacy lurking in the fundamental teachings of chemical science.—I am, &c.,

R. ROUTLEDGE.

London, October 31, 1874.

GASEOUS VOLUMES AND SPECIFIC GRAVITIES.

To the Editor of the Chemical News.

SIR,—In your last number is a paper by Sir F. C. Knowles, calling attention to certain discrepancies between results commonly accepted and certain corrections proposed by the writer. He has, however, used a wrong value for the density of O; relation to air as unity, the density is 1·1 nearly. On substitution of this value in the formulæ, the anomalies noticed by the author will disappear.—I am, &c.,

JAMES BOTTOMLEY, D.Sc.

Taunton College School,
 Taunton, Nov. 2, 1874.

GASEOUS VOLUMES AND SPECIFIC GRAVITIES.

To the Editor of the Chemical News.

SIR,—On carefully looking over the paper on the above-mentioned subject, by Sir F. C. Knowles, Bart., F.R.S., in your last week's issue, I was naturally at first somewhat puzzled at the discrepancies which resulted from his calculations relative to the volumes and specific gravities of CO and its component gases. On, however, reading it a second time, I have, I think, arrived at the solution of the problem. The author assumes, as the specific gravity of O compared with air, the figures 1·6, whereas the true specific gravity of that gas (calculated on the same basis as yields 0·9706 as the specific gravity of CO) is 1·109. If, therefore, he will re-write the equations which follow, substituting in all cases the number 1·109 for 1·6 as the sp. gr. of O, he will, I think, find that the paradoxical results which he obtained will entirely disappear. Thus the formula $\dfrac{C}{O}$, deduced from both series of equations, will be found to give the figures 0·750 in each case, instead of 0·21325 in the one and 0·750 in the other, as stated.—I am, &c.,

A. S., B.D.

London, November 3, 1874.

NOTE ON SULPHINDIGOTIC ACID.

To the Editor of the Chemical News.

SIR,—The following instance of spontaneous decomposition may interest some of your readers. A solution of commercial sulphindigotic acid, after keeping several years, was observed to be turning green. It finally became of a fine chrome-green colour, and a purple precipitate fell. The purple residue, when filtered off, dissolved in water to a blue solution. Sulphurous acid dropped upon the solid precipitate produced no change. This substance seems to be the sulpho-purpuric acid obtained by Berzelius by the action of alkalies on sulphindigotic acid, to which the formula—

$$\left. \begin{array}{l} C_8H_5NO \\ C_8H_5NO \end{array} \right\} SO_3$$
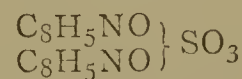
is generally assigned.

The clear chrome-green solution was found to shorten the violet end of the spectrum very considerably. Barium chloride gave a slight dirty-white precipitate. Bromine-water and potassium dichromate instantly decolorised the solution in the cold; dilute nitric acid only on boiling. Sulphurous acid instantly changed the solution from clear chrome-green to indigo-blue. The solution was evaporated to dryness on the water-bath; the amorphous green residue was very soluble in water, and also in alcohol.

When a dilute solution of sulphindigotic acid is mixed with one of hydrogen dioxide, no change takes place; but, if two or three drops of a dilute solution of potassium dichromate be added, oxygen is evolved, the colour of the solution changes to chrome-green, and after some time a purple precipitate falls.

This green substance appears to be identical with the sulpho-viridic acid obtained by Berzelius as the first product of the action of alkalies upon sulphindigotic acid. It is probably the compound of a body intermediate between indigo-blue and isatin with sulphur trioxide—

Indigo.

$$C_8H_5NO$$
$$|$$
$$C_8H_5NO$$

$$\left.\begin{array}{c}C_8H_5NO\\C_8H_5NO\end{array}\right\}O$$

Isatin.

$$C_8H_5NO_2$$
$$C_8H_5NO_2$$

—I am, &c.,

SIDNEY LUPTON.
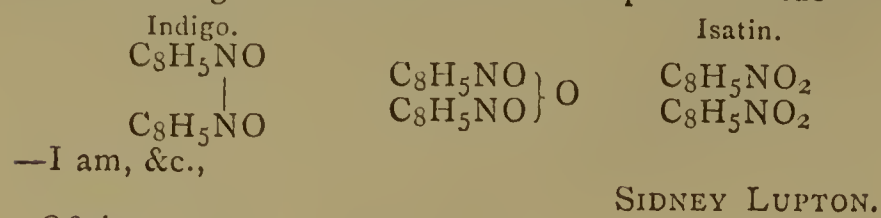
October 31, 1874.

COMMERCIAL ANALYSES.

To the Editor of the Chemical News.

SIR,—The various and vexatious differences that buyers and sellers are constantly meeting with in the analyses of phosphatic and similar materials are sources of great pecuniary loss to some of the parties in the transactions, fertile fields for disputes opening the door to all sorts of suspicions, and more than enough to raise a doubt, in the minds of those not engaged in chemical manipulation, as to the probability, or even possibility, of an accurate analysis by chemical means.

Is not the matter within the control of those interested? With the view of showing that it is, I suggest the following; and, whilst aware that the plan is not perfect, shall be glad if the subject is thereby more fully considered and some satisfactory decisive steps taken.

Let the principal shippers, agents, manufacturers, and buyers form an " Analysis Association " amongst themselves, employing their own chemists, demanding from these a good standard of accuracy, giving to each a liberal remuneration as incentives to carefulness, placing or not placing the result of each chemist in check with those of another; preventing any influence for "high" or "low" results, by the chemists receiving samples only through a reliable officer; and samples, when handed to the chemists, being simply numbered, or otherwise distinguished without names; making each chemist responsible for every analysis he does, by requiring his report signed by himself, and all results to have been obtained by his own personal work.

If one of the principal firms interested issue a circular to others for the above object, and receive a sufficient number of assenting replies, let a meeting be called to formally commence the Association, then some well-known chemists be engaged to act as an examining body. Let invitations be published for candidates to undertake the duties of such analysts, and the examiners then test each candidate in such a way as to ascertain that he is by experience acquainted with the subject, and is a reliable worker. Of the candidates found worthy of confidence, let the examiners appoint one, and, supposing the Association to engage two analysts, report who of the remaining candidates are reliable men; from these let the Association appoint the other analyst. Should more than two be appointed, but still an even number—say, for example, four—let the examiners appoint half, and the Association half; if there be an odd number, then the greater number be appointed by the examiners.

The Association commenced, and the analysts appointed, let a careful person be selected as clerk, to receive samples, make entries of them, and hand them to the analysts, receive analytical reports, and forward them to those whom they concern.

The analysts to receive samples only from the clerk, with simple marks on the samples, seeing that the bottles, seals, &c., are uninjured; to give their attested results to the clerk for delivery; to undertake no other analyses, but give their whole working time to the analyses of the Association; to keep for reference at least half of each sample in case of dispute; in no case to destroy a sample till a year old; to provide their own separate laboratories out of their salaries; and to be paid quarterly.

Persons sending samples for analysis to abandon the present custom of placing particulars of name, ship, quantity, date, &c., on samples, and to agree between themselves upon some distinguishing mark for their samples. To send samples for one or two analysts, as they wish, but if sending to two, then to accept the mean of such two analysts' determinations; unless the differences be beyond a certain limit, to be previously fixed, in which case samples to be obtained back and referred on. For the purpose of such references, the various manufacturers, &c., would not, I am sure, impose too harsh a limit on the differences of manipulation; so that the analysts would not fear frivolous complaints on account of differing results, whilst, of course, they must undertake their posts with the limits allowed for differences previously pointed out, and in each case of difference the chemist decided to have been wrong to pay the fees for such reference analysis. To facilitate such references, let each analyst on his appointment, and afterwards at every six months, name, in common with the others, some chemist by whose results he will abide, such reference chemist's analysis to be taken as confirming that analyst's results whose he most approaches, and negativing that analyst's results he most differs from.

The salaries of the analysts I would propose to be £800 per annum, and of the clerk £200; for an office, one room would suffice; and with a staff of two or three chemists the expenses would be £2000 to £3000 per annum, which sum, if divided over the total weights of materials passing through manufacturers' hands, would not amount to more than a few pence per ton.

It is, of course, supposed that the firms who have private chemists will retain them, and that only the ordinary samples between buyer and seller are the objects of the Association.

By giving the analysts liberal salaries, and placing or not placing each in check with another, there will be sufficient inducement to skilful work; whilst the payment of reference fees by the erring chemist, and the partial discredit if adjudged wrong, will, I believe, reduce results to a fair degree of accuracy, and make cases of reference rare. Should, on reference, the samples be found different, so as to account for differing results, then the analyst should not be held to be in the wrong, and the principals who forward the samples at first to pay reference fees.

To equalise the influence of the Association members, according to their interests therein, let one vote in all matters be given to each member for, say, every £25 of yearly subscription, and, so that one member shall not obtain an undue proportion of work from the Association, let each sample sent in by a member be debited to him at a fixed rate; then, at end of year, if any member has exceeded his proportion in comparison with his subscriptions, or has not required them all, he will have to pay additional, or else be credited proportionately on the next year's subscription.

Non-members sending samples to pay the Association ordinary fees for such analyses, and the fees to become the property of the Association, not the chemist's.

The foregoing to be embodied in the prospectus and rules of the Association, with such other details as shall be found advisable.—I am, &c.,

M. C.

ANTHRACEN ANALYSES.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS of the 23rd inst. we notice a paper from the pen of Mr. R. Lucas " On the Testing of Crude Anthracen," he giving results nearly similar to those we have obtained, and which we hope shortly to publish.

In speaking of Luck's anthrachinon test he says, " I have experimented upon the following admixtures of crude anthracen:—Napthalin, acenapthen, phenanthen, carbazol, pyren, chrysen, and benzerythren. All these tar products submitted to the anthraquinon test were transformed into substances soluble in dilute alkali."

We beg to ask Mr. Lucas whether he operated upon the absolutely pure products above mentioned, and if so, where information may be found relating to their preparation and purification. Our reason for asking this is, that we have been working upon the methods for testing anthracen for the past twelve months, and feel interested in an answer to this query.—We are, &c.

GEORGE E. DAVIS.
T. H. DAVIS.

St. Helens, Lancashire,
October 28, 1874.

FERROUS SULPHIDE IN CHARCOAL.

To the Editor of the Chemical News.

SIR,—In your last number there is a letter signed "R. Speirs." He asserts—(1) That the presence of FeS in char was "supposed" by himself, from certain analyses made by him two years ago; (2) that he examined the deposit at a subsequent period; (3) that his supposition and examination were communicated to me.

As to the first, I do not claim in my paper to be the originator of the idea that FeS exists in char; Muspratt announced it long ago in his article upon bone-black. No analyses exist which *prove* the fact, Mr. Speirs's assertion nevertheless.

(2). No more did I claim the kiln-pipe deposit as a discovery of mine. I expressly said that it occurred more or less in all houses. When found in excessive amount, it is the result of gross overheating. For obvious reasons, it would not have been courteous to associate the name of one who had the oversight of kiln-pipes with such a substance. Although others have seen the interesting stranger, as well as Mr. Speirs, in other refineries, no one can object to his claiming its paternity, and "Speirs's Pipe Deposit" will keep fresh in our memories a relic of the sulphur age.

(3). My paper was an attempt to *prove* (not to suppose) that FeS was the char sulphide. The deposit does *not* prove that, but my experiments quoted I respectfully submit do. For these I am solely indebted to myself. The analyses given of "Speirs's deposit" were done by my assistant and myself. The ideas of the *experiments* originated every one from me. What Mr. Speirs may have said to others he knows best himself; but if he has asserted that he was the author of a single experiment, or did one figure in the paper, or communicated the slightest information to me on the subject, he is not only "uncourteous," but guilty of something else.—I am, &c.,

R. FRAZER SMITH.

Greenock, October 31, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 12, September 21, 1874.

Sulpho-Carbonate of Baryta.—P. Thenard.—The interest taken in the sulpho-carbonates since they have been applied by M. Dumas to the destruction of the phylloxera has drawn attention to various methods for their preparation. If we agitate, for a few minutes only, a solution of sulphide of carbon, ever so little concentrated with sulphide of carbon, there is quickly deposited a canary-yellow powder, crystalline, and very dense, which is pure sulpho-carbonate of baryta. The purification consists merely in washing in alcohol to remove excess of sulphide of carbon, followed by desiccation in a vacuum. On the large scale, the process is also very simple. Taking the mother-liquor left from a former operation, we pour into it a solution of sulphide of barium, as hot and concentrated as possible, until the temperature rises to 15° to 18° above the atmosphere, but does not exceed the maximum of 40°. Into a certain quantity of this mixture we pour a dose of sulphide of carbon, less than what it can absorb, and stir the mixture briskly from time to time for a period of five to six hours, or rather, till the smell of sulphide of carbon has sensibly disappeared. The whole is then poured into one of the settlers where the sulpho-carbonate is intended to accumulate. As it deposits and accumulates rapidly, it is very easy to decant the liquid after the lapse of twenty-four hours. The water thus run off is then treated with a fresh dose of sulphide of carbon, relatively in large excess. The stirring this time is kept up for twelve to fifteen hours, with intervals of rest as before. A fresh amount of sulpho-carbonate is deposited at the bottom of the vessel. The liquid is then run off, taking care not to pour away the sulphide of carbon in contact with the precipitate. The water drawn off is the mother-liquor, properly so-called, used at the outset of the operation. This mother-liquor having been decanted off, is replaced by the mixture of sulphide of barium and mother-liquor of the sulpho-carbonate, and agitated as before until all the sulphide of carbon has been utilised. It is, however, desirable to convert the sulpho-carbonate of baryta into the corresponding potash salt, both because the latter is more soluble, and because potash is beneficial to vegetation, whilst baryta is probably destructive.

New Mercurial Pneumatic Apparatus.—M. de Las Marismas.—The structure of the apparatus cannot be made intelligible without the accompanying diagram. It is said to have the following advantages :—It is easily constructed and inexpensive, not costing more than 35 frs. It is rapid in action, and does not fatigue the operator. A vacuum is obtained at about 1 millimetre, in a receiver of 6 litres in four minutes. Experiments can be made at all pressures between that of the atmosphere and an absolute vacuum. It works automatically, and avoids all the errors which may happen with mercurial pneumatic machines where the taps are moved by hand. It holds its vacuum for an indefinite length of time.

Action of Alimentary and Medicinal Liquids upon Utensils of Tin containing Lead.—M. Fordos.—The author has examined the alloys of tin and lead used in the manufacture of divers vessels and utensils, and in tinning culinary apparatus, and has obtained very important results. It appears that an alloy of tin is used in hospitals, pharmaceutical establishments, &c., containing 10 per cent of lead. This is easily attacked by vinegar—even if much diluted—wine, lemonade, &c., and a notable and dangerous quantity of the poisonous metal.

Researches on the Colouring Matters of Madder.—A. Rosenstiehl.

Further Experiments on the Nature of the Sulphurous Principle of the Waters of Luchon.—M. F. Ganigot.—When these waters are desulphuretted by sulphate of lead, perfectly neutral, they become acid.

Luminous Diffusion.—A. Lallemand.—Not adapted for abstraction.

On Warwickite.—J. Lawrence Smith.—Professor Shephard, who first described this mineral, confounded two distinct substances—warwickite, properly so-called, in small slender crystals, and an impure variety of the same crystalline form, but containing merely a small portion of the true mineral. Later, Prof. S. Hunt gave the name enceladite to the impure variety, whose composition he gives as—

Titanic acid	31·5
Magnesia	43·5
Ferric oxide	8·1
Loss on ignition	2·0

85·1

The author's analysis of the mineral, carefully selected, and freed as far as possible from crystals of spinel, is—

Boracic acid	27·80
Titanic acid	23·82
Magnesia	36·80
Ferrous oxide	7·02
Silica	1·00
Alumina	2·21
	98·65

The silica and alumina are impurities, the latter derived from spinel. The titanic acid contained a trace of iron. The composition of the mineral appears therefore as—

$$3Bo + 2Ti + 6Mg + Fe, \text{ or } Mg_5B_3 + (MgFe)Ti_2.$$

It is the only boro-titanate occurring in nature. In the same locality is found a titaniferous iron containing 15 per cent of magnesia, which, according to Rammelsberg has the formula—

$$MgTi + FeTi.$$
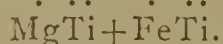
Moniteur Scientifique, du Dr. Quesneville, September, 1874.

The Sulphur Industry of Sicily.—Sulphur in its natural state is found in many parts of the globe, but nowhere (?) in so great plenty as in Sicily. It was found first as a deposit resulting from recent volcanic eruptions —called in Italy solfatare—and afterwards deep-lying beds, where it is associated with sedimentary rocks (solfare). The amount of native sulphur furnished by the former is very trifling. Pouzzali, near Naples, is at present abondoned. Vulcano, in the Lipari Islands, yields 200 quintals of 100 kilos. yearly. The mines of sulphur, strictly so-called, have a far greater importance. Except in Italy, the chief are those of Radoboy in Croatia, Szwoswice in Gallicia, Czarkow, the Isle of Milo, Apt in the Vaucluse, Murcia. Bohar on the Red Sea, &c. The sulphur mines of the Romagna produce yearly more than 120,000 quintals. The Sicilian mines yield 180,000 tons of crude sulphur, without reckoning the enormous amount wasted by the treatment of the ore, The mines are scattered in the provinces of Caltanisetta, Girgenti, and Catania, besides two isolated beds, those of Lercara in the province of Palmero, and of Gibellina in Trapani. The exports of sulphur in 1871 were as follows:—

To France..	16,909	tons.
England	31,036	,,
America	41,758	,,
Other countries	81,533	,,
	171,236	

The quantity taken by France and by England appears to be declining, whilst the demand in America and in other countries is increasing. The author calculates that in fifty to sixty years the Sicilian mines will be exhausted. The treatment of the ore is very primitive: it is a simple fusion, where the sulphur itself serves for fuel, and which is carried on almost in the open air without any regard to waste. Thus the ore which contains 15 to 40 per cent of sulphur yields only 10 to 25. Great damage is also done to agriculture, and to the health of the workmen. Various improved methods have been tried, but prove too costly, chiefly on account of the high price of fuel. In 1871 the price of a quintal of sulphur, delivered on board ship in a Sicilian port, was 12 francs, including the export duty of 1 franc. Before the expiration of two years, thanks to the railways, the price will be reduced to 10 frs. 50 cents, which, by suppressing the duty, might be lessened to 9 frs. 50 cent. Sicilian sulphur could thus be delivered at about 12 frs. at Marseille, and 12 to 13 frs. in the ports of England and the North Sea. The use of pyrites instead of sulphur represents a saving of 4 frs. per quintal at Marseille; 6 frs. in Belgium and Northern France; and 5 to 6 francs in England. Native sulphur, as compared with pyrites, offers certain practical advantages, which,

according to Balard and Parodi, may be valued at 2·27 frs. per quintal. The economy of using pyrites is thus reduced per quintal to 1·73 frs. in Marseille, 3·73 frs. in Belgium, and 3·23 frs. in England. The author concludes that the manufacture of chemical products in Italy will always be restricted by the scarcity of fuel.

Discovery of Crystalline Digitaline.—C. Nativelle.

New Method of Preparing Salicylic Acid, and on some of its Properties.—H. Kolbe.—Neither of these papers are suitable for abstraction.

Observations on Bleaching Woollen Goods.—M. J. Persoz.—Reserved for insertion in full.

Steaming Process in Calico Printing.—A. Schultz. —The author describes the various arrangements for steaming printed pieces, and gives the preference to the French apparatus, *a poehes tournantes,* an engraving of which is added. The English steam-chest he considers suitable for wood colours, " with which the English have inundated all parts of the world except France," but less adapted for alizarin and extract of madder styles. For the latter colours he recommends to begin steaming at a very low pressure, increasing it gradually every twenty minutes, up to a half atmosphere in two hours.

Action of Nitric Acid upon Paraffin.—A. Gabriel Pouchet.—This paper is noticed elsewhere in the CHEMICAL NEWS.

Determination of Gaseous Sulphurous Acid.—A. Gabriel Pouchet.—Useless without the accompanying diagram.

Use of Naphthalin in the Preparation of Colouring Matters.—Prof. M. Ballo.—The author mixes naphthylamin and bromide of naphthalin in equivalent amounts, and heats them to ebullition in an open vessel, when the mass takes a dark colour, and appears by transmitted light of a dull red. Prolonged heating in the water-bath gives the same result. After cooling the mass remains liquid. It is extracted with ether, when a dark powder remains, which dissolves in alcohol with a fine violet colour. This is the hydrobromate of a base precipitable from its alcoholic solutions in blue flocks on the addition of much water and a little ammonia. These flocks are filtered off, dissolved in alcohol, and mixed with sulphuric acid. On evaporation the sulphate remains, forming a thin layer of a cupreous metallic lustre. The yield is very small. The action of the air seems necessary for the production of the colour.

Bulletin de la Societe Chimique de Paris, tome xxii., Nos. 4 and 5, September 5, 1874.

New Isomer of Saccharose.—Arm. Gautier.—The author has obtained, by dehydrating dextro-glucose, a new compound having the composition $C_{12}H_{22}O_{11}$. It is anhydrous, and is formed by the union of two equivalents of glucose, with elimination of water. It is a colourless body, in taste and appearance resembling dextrin or gum, very soluble in water, very hygroscopic, and cannot be entirely freed from water unless heated for some hours in a current of dry carbonic acid gas. In contact with the yeast of beer it does not ferment.

Correspondence from St. Petersburg.—W. Louguinine.—Notices of papers read before the Russian Chemical Society, March 7.

Removal of Grease from Wool.—M. J. L. Larcade. —Wools in their natural state contain suint and grease, which can only be removed by alkaline lyes. On the other hand, in order to spin them they must be saturated with a certain quantity of oil, which forms with dust, &c., residues not easily utilised. If the wool is brought in contact with sulphate of lime all the fatty matter is absorbed; the fibres are rendered absolutely dry, and all the solid foreign bodies can be afterwards removed by beating. A cylinder, fitted with spikes, works inside a closed drum. At one of the ends of the drum is a self-

acting feeder, which throws the wool or the rags upon the spikes of the cylinder. A sieve, moved by an excentric, constantly sifts anhydrous sulphate of lime into the interior of the drum. The spikes which divide the filaments facilitate the saturation. A beater, with a blowing apparatus, expels afterwards the sulphate of lime saturated with grease, along with all the foreign matters.

Application of Cerulignon on Tissues.—M. Marx.— This substance, the cedriret of Reichenbach, dissolves in sulphuric acid with an indigo blue, and in creosote with a reddish purple. Fisher, of Stuttgard, produces with it a bright orange upon wool and silk. The cerulignon paste is dissolved in alcohol, and re-precipitated with water. The precipitate is thickened with gum, and printed upon silk or wool. After drying and steaming the printed parts appear colourless, though before the steaming they were slightly coloured. After washing, and passing through perchloride of iron or chromate of potash, the printed portions rapidly take a fine orange.

Accidental Colouration of White Lead.—G. C. Wittstein.— The reddish colouration occasionally found in white lead has been ascribed by Baker to the presence of silver. MM. Bannow, Kraemer, and Lorscheid attribute it to minium. The author has met with a sample in which the reddish grey colouration was due to ferric oxide. This sample dissolved in acetic acid, leaving 2·25 per cent of an insoluble residue, containing silica, sulphate of lead, and ferric oxide.

Researches on Ultramarine.—M. B. Unger.— The author considers soda as forming an integral part of ultramarine. The amount of free sulphur he considers equal to one-sixth of the total sulphur.

Galvano-Plastic Coppering of Cast-Iron Rollers for Calico Printing.—G. Schæffer.— Many attempts have been made in this direction by Lokett (Lockett ?), L. Huguenin, and Schlumberger. One of the defects of the coppered rollers was that they were capable of losing their true form—an accident easily remedied upon a cylinder of copper, but not upon those of coppered iron. Th. Schlumberger cleanses the iron cylinders with a concentrated alkaline lye, washes well in water, and goes over the whole surface with the file. The surface is then very bright, and is not to be touched with the fingers or soiled with the breath. It is then plunged in an alkaline bath composed of—

Sulphate of copper	1 part.
Dissolved in water	12 parts.
Cyanide of potasium	3 parts.
Carbonate of soda	4 ,,
Sulphate of soda	2 ,,
Dissolved in water	16 ,,
Or, Ammonia	3 parts.
Acetate of copper	2 ,,
Dissolved in water	10 ,,
Cyanide of potassium	3 parts.
Carbonate of soda	4 ,,
Sulphate of soda	2 ,,
Dissolved in water	10 ,,

The cylinder is allowed to remain twenty-four hours in one of these baths, subject to the action of a battery of 4 or 6 pairs, till the surface is coated with a slender but adherent layer of copper. It is washed and cleansed with pumice-stone. If in this operation the iron should be laid bare in any part, the cylinder must be anew submitted to the alkaline bath. As soon as the coating of copper is uniform it is washed in acidulated water, and immersed in an acid bath of sulphate of copper. This bath is composed of solution of copper at 20° B., to which 1-300th of its volume of sulphuric acid is added to facilitate the solution of some metallic copper, which is also immersed in the bath for the purpose of maintaining the solution in a uniform state of concentration. Here the cylinder is left till the layer of copper has attained the desired thickness, a galvanic current being kept up by a battery of four pairs.

If the temperature is between 15° and 18°, three to four weeks are required to produce a deposit of three-quarters of a millimetre in thickness. The cylinder is turned one quarter round daily to change the portion of its surface which faces the sheet of copper used as a positive electrode.

Formation of Molasses.—F. Anthon.— Certain authors classify the bodies which accompany sugar, whether organic or inorganic, into products determining the formation of molasses, products preventing it, and indifferent bodies. The author, having undertaken a series of experiments to verify this view, finds that one and the same body may, according to proportions, either favour crystallisation, hinder it, or remain indifferent. The classification above mentioned is, therefore, not well founded.

Reimann's Farber Zeitung, No. 38, 1874.

This number contains a continuation of the directions for dyeing felt hats; instructions for removing spots from garments to be re-dyed; a receipt for an aniline green on silks, the peculiarity of which is that the goods are grounded with aldehyd green, and afterwards topped with iodine green mixed with picric and acetic acids.

There is a notice that the manufacture of Croissant and Bretonnière's patent colours at Göttingen has been suppressed by the police authorities as a nuisance.

Receipts for Printing Woollens.—*Scarlet.*—

Starch	4½ lbs.
Cochineal liquor at 6° B.	18 litres.

Incorporate at a boil, and add—

Tin crystals	9 ozs.
Oxalic acid	1½ lbs.
Solution of tin crystals at 6° B.	2½ ,,
Fustic liquor at 15° B.	1½ ,,
Oil of turpentine	½ litre.

Black.—

Extract of indigo	½ lb.
Crystalline chloride of ammonium	¼ ,,
Calcined starch	16 lbs.
Extract of logwood at 7° B.	16 litres.

Boil, stir till nearly cold, and add—

Nitrate of iron at 55° B.	2 lbs.
Chloride of iron at 45° B.	1 lb.

Stir till cold, and add—

Oxalic acid	2 ozs.
Chromate of potash	4 ,,

The longer this colour is preserved the finer the black becomes.

Dark Brown.—

Starch	24 lbs.
Burnt starch	24 ,,
Extract of indigo	10 ,,
Crystalline chloride ammonium	2 ,,
Extract of orchil	208 litres.
Water	20 ,,

Boil, and add—

Alum	16 lbs.

Blond.—

Extract of indigo	1¾ ozs.
Alum	½ lb.
Oxalic acid	¼ ,,
Extraction of fustic	} as required.
Extract of orchil	
Gum water	

Green.—

Extract of indigo	15 ozs.
Alum	5 lbs.
Oxalate of potash	25 ozs.
Yellow paste	18 lbs.
Gum water	as required.

*Yellow Paste.—*Precipitate the decoction of fustic with a little sulphuric acid and bichloride of tin; filter the whole, let the sediment drain on the filter, and use it whilst still moist.

Next follow receipts for dyeing ombrés and double ombrés; for printing calico with aniline colours; and for dyeing a fast black upon cotton-wool capable of bearing the stocks.

The chemical section of the Société Industrielle de Mulhouse has expressed an opinion that the colours of Croissant and Bretonnière furnish very fast, though not brilliant, shades both in dyeing and printing, and will be applicable in simple but very fast styles.

J. Casthélaz, of Manchester, prepares aniline brown and black by treating aniline and nitro-benzol with sulphuric acid in excess and bichromate of potash, with or without the application of heat. The soluble colouring matter, when extracted, yields upon wool a brown colour, which becomes black on passing it first through chromate of potash, and then through an alkaline bath.

MISCELLANEOUS.

Death of Dr. T. Anderson.—With regret we announce the death of Thomas Anderson, M.D., F.R.S.E., formerly Professor of Chemistry in the University of Glasgow. He died at Chiswick, on the 2nd inst.

Physical Society.—The first meeting of the Session 1874-5 will be held at three p.m. to-morrow, Saturday, November 7th, 1874, in the Physical Laboratory, Science Schools, South Kensington, when the following communications will be made to the Society:—"On Graphical Methods of Treating certain Elementary Electrical Problems," by Prof. G. C. Foster. "On an Instrument for Multiplying Small Motions," by Mr. G. F. Rodwell. "On Salt Solutions and Water of Crystallisation," by Prof. F. Guthrie.

NOTES AND QUERIES.

Petroleum Query.—Is there any substance known that will drown the odour of petroleum oil, or diminish the unpleasant smell of it?—W. Hughes.

Condensing Towers.—Some years ago I planned a system of condensing towers (for wet) and horizontal or any angle for gases, which I have never yet seen equalled for efficiency, assuming that the greatest amount of surface available in least possible space is efficiency. I showed it to Dr. Lünge, of Newcastle, and Mr. Reed, of Blaydon Co., and both said it was better, even for Mr. Deacon's process, than his marbles. My object in writing is to ask you what is the *most conclusive* experiment I could make, in a small way, to prove efficiency. To patent, is to publish *pro bono pub.* gratis; and to get a manufacturing chemist to try it is difficult, even if you could depend on him. I should like to put up some small arrangement in which I could show that I could condense at such and such a rate, from which larger apparatus could be illustrated. If you can suggest such an arrangement or experiment, I should be much obliged.—John Cliff.

TO CORRESPONDENTS.

G. Combe Stewart.—Your communication arrived too late for insertion in the present number.

THE CHEMICAL NEWS.

VOL. XXX. No. 781.

PREPARATION OF SULPHOVINIC ACID AND ITS SALTS.

By T. L. PHIPSON, Ph.D.

THE preparation of sulphovinic acid is by no means an easy operation, and, as certain compounds of this acid are now beginning to be used in medicine, perhaps the following observations may not be devoid of some practical interest.

When sulphuric acid and alcohol are mixed together without any special precautions, the temperature rises, and a certain quantity of sulphovinic acid is formed at once; but, as in the formation of this acid a certain proportion of water is set free, and prevents the continuation of the reaction, it is never completed, even after the mixture has been kept for some hours in a water-bath, and at a higher temperature decomposition at once ensues. It may, nevertheless, be quite possible to obtain a sulphovinic acid tolerably pure with alcohol and sulphuric acid alone (instead of the present tedious method based on the decomposition of the baryta salt), by keeping the mixture at 100° for two or three days and not acting upon too large a quantity. I intend to try this experiment shortly.

To obtain sulphovinate (ethyl-sulphate) of lime, it is best to mix equal volumes of concentrated sulphuric acid and alcohol; they may be mixed without any special precautions when small quantities only are used, and the uncovered vessel containing the mixture must be transferred to a water-bath and kept there eight or ten hours at least, during the whole of which time the temperature should be 100°, or nearly. The liquid will then have acquired a slight degree of fluorescence and a decided odour of ether (not an odour of sweet oil of wine), and should be only very slightly coloured. When cool, it is added, drop by drop, to about twenty times its volume of cold distilled water, carefully avoiding any rise of temperature, and keeping the liquid well stirred. This solution is saturated with pulverised chalk, added in small quantities at a time, until effervescence ceases. When a slight excess of chalk has been added, filter off the sulphate of lime, heat the filtrate in the water-bath with a little carbonate of lime for about half an hour, filter while warm, and evaporate at a heat not exceeding 100° till a permanent saline layer forms at the surface;* then place the capsule in a dry and moderately dry place. In about twenty-four hours the crystals are formed; the mother-water will give another crop when allowed to evaporate over sulphuric acid or chloride of calcium. If the chalk contains iron or manganese, their sulphovinates remain in the mother-water, and are perfectly separated by pressing the crystals.

Sulphovinate of lime crystallises rather slowly, even in very concentrated solutions; it forms large, brilliant plates, something like chlorate of potash; its composition is represented by $C_4H_5O,SO_3 + CaOSO_3 + 2HO$; it is very soluble in water and in alcohol. The impure salt can easily be purified by re-crystallisation from alcohol.

Sulphovinate of baryta has a similar composition and similar properties; it can be obtained in the same manner. When the crystals are pure, they form very large, brilliant plates, oblique rectangular prisms, modified in certain angles. Both this salt and the lime-salt often present a peculiar pearly aspect, which I do not observe on small pure crystals; these are perfectly transparent, and I believe this pearly aspect to be mainly owing to minute quantities of carbonate or sulphate dispersed through the larger crystals.

The sulphovinate of soda could be obtained pure from either of these salts without difficulty, but, for the preparation of the pharmaceutical product on a large scale, it is more economical to make it directly. I hope to refer again to this compound.

London, November 9, 1874.

ON THE DETERMINATION OF IRON IN CLAY-IRONSTONES CONTAINING PYRITES.

By W. F. K. STOCK, F.C.S, and W. EDWIN JACK.

THE method usually adopted in assaying clay-ironstones is as follows:—1 grm. of the ore is treated with strong hydrochloric acid at nearly boiling-point for about twenty minutes. The solution is diluted with hot water to about 400 c.c., and, without being filtered, is brought to the boiling-point, reduced by a suitable reagent, and titrated by a standard solution of potassic bichromate.

As a rule, this process yields very satisfactory results; but, some years since, one of us, in making a cursory examination of a complete section of a well-known iron deposit in the Cleveland district, noticed the occurrence of a small band of ore some 4 to 6 inches in thickness, containing a considerable amount of organic matter, and also, as it afterwards proved, a large quantity of iron pyrites. In assaying a sample from this band by solution in hydrochloric acid, reduction with stannous chloride, and titration by potassic bichromate, it was found that, after the ferrous chloride had been completely oxidised by the potassic bichromate, a gradual reduction spontaneously occurred and several cubic centimetres of the oxidising solution were required before the potassic ferricyanide again indicated a total absence of ferrous salt.

We have lately submitted the ore in question to a careful examination, and we find that the reproduction of ferrous salt is owing, partly to the formation of ferrous sulphate, arising from the oxidation of the pyrites by atmospheric oxygen, and partly to the reduction of ferric chloride by sulphurous acid simultaneously generated, according, as we believe, to the following equations :—

$$FeS_2 + O_6 = FeSO_4 + SO_2,$$

and—

$$Fe_2Cl_6 + SO_2 + 2H_2O = 2FeCl_2 + H_2SO_4 + 2HCl.$$
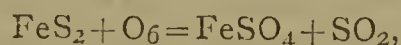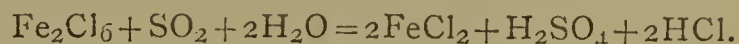
In order to note the degree in which the pyrites interfered with the usual reaction, we made the following determinations :—

(1). The sulphur in the ore was carefully determined, when 16·8 per cent was obtained, which represents 31·5 per cent of ferric sulphide.

(2). One grm. of the ore was treated with hydrochloric acid, and assayed in the usual way, when 23 per cent of metallic iron was indicated. After allowing the solution to boil for a few minutes, it was found that a considerable reduction had occurred, which increased to such an extent that, in half an hour, it was necessary to add bichromate equal to 50 per cent of metallic iron before a negative reaction with potassic ferricyanide was obtained.

(3). One grm. of ore was treated with hydrochloric acid, the solution filtered and titrated as before, the result being an indication of 18·75 per cent of metallic iron. No after reduction was observed.

(4). One grm. of ore was first calcined, then treated with hydrochloric acid, and the insoluble portion, which still contained a notable quantity of iron, filtered off and fused with sodic carbonate. The iron obtained in this experiment, which, of course, is the true amount, was 30·1 per cent. A check assay was made, when 30 per cent of iron was indicated.

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* During this evaporation, a slight, but distinct, odour of butyric acid is perceptible.

As we have noticed similar discrepancies occurring in the assay of ores from different localities, we recommend that, in all cases where much organic matter is present, the ore be first calcined, then fused with alkaline carbonate, dissolved in hydrochloric acid, and titrated as usual; as in ores of this class organic matter and pyrites are naturally associated.

ZINC BLENDE FROM AN ANTIMONY MINE.

By ROBERT FRAZER SMITH, F.C.S.

As far as I have heard, there are only two antimony mines in Great Britain, one at Glendinning, Dumfriesshire, and the other at New Cumnock, Ayrshire. The first was pretty extensively worked for some time, but is now at present neglected; the second was opened up a generation ago, and again recently, with what success remains to be seen. It has appeared to me very strange that, especially at the Cumnock mine, not a specimen can be picked up of any sulphide but antimony. At Leadhills, copper, zinc, antimony, and other sulphides occur in abundance. At the famous Australian antimony mine, no distinct specimens of blendes can be procured.

But, some time ago, specimens of antimony ore were sent to me from Glendinning which had peculiar black crystals intermixed with the steel-coloured antimony ones. Happening recently to be at leisure, I found, on analysis, they contained as follows:—

Zinc	62·84
Antimony	1·12
Iron	0·49
*Calcic carbonate	1·95
Sulphur	32·50
Insoluble and loss	1·10
	100·00

* The matrix was calc spar.

This is the first instance I have heard of zinc occurring in the same vein with antimony, where the latter formed the staple of the vein.

ON ANTHRACEN AND ALIZARINE.*

By FREDERICK VERSMANN, Ph.D.,

(Continued from page 214.)

I HAVE tabulated a number of experiments with genuine commercial samples of various makers from different parts of the country; they are the result of 400 alcohol tests and of 250 bisulphide of carbon tests, and the deductions drawn from these figures strikingly show the difference of the two tests, and also the low quality of the product sold at present:—

ALCOHOL TEST OF 400 COMMERCIAL SAMPLES.

Melting-Points.	Below 10 per cent.	10 to 20 per cent.	20 to 30 per cent.	30 to 40 per cent.	40 to 50 per cent.	50 to 60 per cent.	60 to 70 per cent.	70 to 80 per cent.	80 to 90 per cent.
Deg. Cent.									
Below 160	—	1	—	1	—	1	—	—	—
160—170	—	—	1	—	1	1	—	—	—
170—180	—	2	4	3	3	—	—	—	—
180—185	—	1	11	16	3	2	1	—	—
185—190	—	7	21	30	20	18	5	—	—
190—195	—	24	35	48	51	21	13	2	—
195—200	2	9	6	10	5	6	5	2	1
Above 200	—	1	1	1	—	1	1	2	—
Total	2	45	79	109	83	50	25	6	1

* Read before the Society of Arts, Chemical Section.

BISULPHIDE OF CARBON TEST OF 250 COMMERCIAL SAMPLES.

Melting-Points.	Below 10 per cent.	10 to 20 per cent.	20 to 30 per cent.	30 to 40 per cent.	40 to 50 per cent.	50 to 60 per cent.	60 to 70 per cent.	70 to 80 per cent.
Deg. Cent.								
195—200	—	2	1	—	2	—	—	
200—205	4	13	16	12	9	4	—	—
205—210	5	24	47	35	6	—	4	—
210—215	2	11	32	8	4	—	—	—
215—218	5	—	—	—	2	—	—	2
Total	16	50	96	55	21	6	4	2

In summarising these figures, we find with the alcohol test out of 400 samples:—

47, or about 12 per cent, contain less than 20 per cent insoluble.
79,   ,,   20   ,,   ,,   from 20 to 30   ,,   ,,
109,   ,,   27   ,,   ,,   ,, 30 ,, 40   ,,   ,,
83,   ,,   21   ,,   ,,   ,, 40 ,, 50   ,,   ,,
50,   ,,   12½   ,,   ,,   ,, 50 ,, 60   ,,   ,,
32,   ,,   8   ,,   ,,   above   60   ,,   ,,

Again, as to the melting-point we find:—

153, or about 38 per cent, melt below 190 deg. C.
194,   ,,   48   ,,   ,, between 190 to 195 deg. C.
46,   ,,   12   ,,   ,,   ,,   195 ,, 200   ,,
7,   ,,   2   ,,   ,, above   200   ,,

Looking at the bisulphide of carbon test, we find equally satisfactory results, viz., out of 250 samples—

16, or about 6 per cent, contain less than 10 per cent insoluble.
50,   ,,   20   ,,   ,,   from 10 to 20   ,,   ,,
96,   ,,   38   ,,   ,,   ,, 20 ,, 30   ,,   ,,
55,   ,,   22   ,,   ,,   ,, 30 ,, 40   ,,   ,,
21,   ,,   8   ,,   ,,   ,, 40 ,, 50   ,,   ,,
12,   ,,   5   ,,   ,,   above   50   ,,   ,,

Again, as to the melting-point we find:—

5, or about 2 per cent, melt between 195 to 200 deg. C.
58,   ,,   23   ,,   ,,   ,,   200 ,, 205   ,,
121,   ,,   48   ,,   ,,   ,,   204 ,, 210   ,,
57,   ,,   23   ,,   ,,   ,,   210 ,, 215   ,,
9,   ,,   4   ,,   ,,   ,,   215 ,, 218   ,,

I am indebted for these figures to my friend Mr. Manning, in whose laboratory these analyses have all been made in the course of last year; they fairly represent the quality of anthracen met with in the market at that time, and I do not think any sensible improvement has taken place since. Surely the manufacturer must soon find it to his own advantage to supply a higher class article.

With the alcohol test we have 80 per cent containing less than 50 of insoluble, but only 2 per cent of more than 70 per cent of insoluble, which is the lowest quality the alizarine maker could use. Taking the melting-point, we have 38 per cent below 190° C., the lowest melting-point at which the article is at all saleable, and only 2 per cent above 200° C., which is not even the true melting-point.

With the bisulphide of carbon test we have 94 per cent, with less than 50 per cent of insoluble, and only 5 per cent above that, while the melting-point in all samples is much better, only 2 per cent below 200° C., and 94 per cent between 200° and 215° C.

To show the comparative value of the two tests, it was necessary to make a series of experiments with both alcohol and bisulphide, and the following list gives a few of such experiments. I have purposely selected a great variety, from the lowest to the highest quality, which will bring out several points most prominently. I have given the results in round numbers, omitting the decimals, both in percentage and temperatures. (See next column).

These thirty experiments represent samples varying with the alcohol test from 20 to over 70 per cent, with a melting-point running from 154° to 211° C., while the bisulphide of carbon test varies from 5 to over 70 per cent, with a melting-point of from 201° to 218° C.

The relative proportion between the two tests fluctuates with bewildering variety. With the low percentage the

COMPARATIVE RESULTS OF ALCOHOL AND BISULPHIDE OF CARBON TESTS.

Alcohol		Bisulphide of Carbon	
Per cent.	Melting-point. Degs. C.	Per cent.	Melting-point. Degs. C.
20	154	5	212
20	184	5	204
22	165	5	218
25	177	13	209
27	187	18	207
27	183	15	208
28	181	13	209
30	184	10	208
32	184	21	205
35	183	21	209
36	181	18	202
38	180	22	203
41	184	27	208
42	188	28	211
43	191	31	204
44	189	32	207
46	192	31	209
47	188	32	207
50	192	36	207
51	198	42	212
33	194	36	209
54	157	10	204
56	185	40	201
57	189	43	205
58	183	41	201
59	190	42	203
61	198	50	211
64	200	61	208
69	201	64	208
72·5	211	74	213

difference is as much as 4 to 1, with a vast difference in the melting-point; but the higher the percentage the more uniform it becomes; nay, with the last sample the alcohol is actually lower than the bisulphide with nearly the same melting-point, namely 72·50 per cent 211° C., against 74 per cent 213° C.

Looking at the melting-point only in all these tables, the bisulphide of carbon series are the most reliable as approaching the quality of pure anthracen; the last table of alcohol test gives only one-third melting above 190° C., whilst the previous table gives about two-thirds, the rest being only indifferent.

If we want to compare the two tests, we can take only those alcohol samples which melt at or above 190° C. We then find the average proportion to be about 3 to 2, but as we know that the one product is much purer than the other, it must be clearly understood that it is so much more valuable, and no attempt should be made to simply substitute the one test for the other. However, under all circumstances, it will be desirable to improve the quality generally and to increase the percentage, especially by separating the oil as much as possible. But as long as this is not done, I would propose to wash the samples to be tested with light petroleum spirit, and to press and to dry them before using either alcohol or bisulphide; thus a more correct result will be obtained, and in case this should be adopted, more uniformity in the analysis would be insured. But, after all, these tests only give approximate results, and the want of a truly scientific treatment has long been felt. Now in producing alizarine from anthracen, the first step is to convert it into anthrachinon, and this reaction appears to be capable of adoption for analytical purposes.

Mr. Luck, a chemist at Meister Lucius and Co's., published, some months ago, in the *Berichte der Deutschen Chemischen Gessellschaft*, the following details of an—

ANTHRACHINON TEST.

Heat in a flask 1 gramme of anthracen together with 45 c.c. glacial acetic acid till it gently boils; add gradually, and at intervals of 5 to 10 minutes, a solution of 10 grammes of chromic acid in 5 c.c. of glacial acetic acid and 5 c.c. of water. To prevent any loss of acetic acid during boiling, the flask is mounted with a condenser, which allows the acid constantly to flow back. About two hours gentle boiling in most cases completes the decomposition, after which allow to cool, add 150 c.c. of water, and let stand for a couple of hours. Light yellow needles of anthrachinon separate from the green liquid. Bring the whole on a filter, wash the crystalline residue first with water, then with a very dilute, hot solution of potash, until the liquid runs off perfectly colourless; and, lastly, again with water, to remove traces of alkali. Now dry the filter in a water-bath, and when perfectly dry detach the anthrachinon with a spatula, and weigh. This last direction is given in preference to weighing the residue and filter, because it has been found that the dilute chromic and acetic acid dissolve part of the filter, the original weight of which would thereby be altered.

Before calculating the anthracen from the anthrachinon obtained, a correction must be made; it has been found that 50 c.c. of acetic acid and 150 c.c. of water, as used above, dissolve 0·010 gramme of anthrachinon, which must be added to the weight actually found.

If the anthracen contains sand, or other impurities insoluble in acetic acid, a previous filtration through a small filter becomes necessary; very oily samples have to be pressed first between blotting-paper. Now, this test is based upon the argument that chemically pure anthracen yields the theoretical quantity of chemically pure anthrachinon, and that the other hydrocarbons are either destroyed by oxidation, or are converted into compounds readily soluble in diluted alkali.

I think as far as the experiment with pure anthracen goes, the result may be satisfactory, and after having ascertained that the quantity of acid and water used dissolved anthrachinon which corresponds exactly to one per cent of the sample, the above correction may possibly be admitted, although it is rather a novel addition to analytical chemistry; but as soon as we have to do with a mixture, the conditions are changed, and such corrections would make the analysis worthless. Another drawback is the necessity of detaching the anthrachinon from the filter, which is simply impossible without scraping off some paper and losing some crystals.

But a still more serious objection is the fact that some of the other hydrocarbons are acted upon in precisely the same manner as anthracen, and their products are as little soluble in dilute alkali as anthrachinon itself.

Phenanthren dissolved in acetic acid is very slowly oxidised by chromic acid, so that after six or eight hours boiling much is left unaltered; the phenanthrachinon forms needles of an orange colour, which melt at 205° C., and may thereby be distinguished from anthrachinon, which melts at 273° C., but phenanthrachinon is further decomposed in biphenic acid, $C_{14}H_{10}O_4$; but this is a later reaction.

Chrysene treated in a similar manner yields also a chinon, in orange-yellow needles, insoluble in alkali.

Thus we see two at least of the impurities, and perhaps the two most important ones, form similar compounds to the one which should stand out alone in the whole series; the attempted separation is not complete, and the test is highly unsatisfactory. On the one hand the results are too low, and on the other hand they may be too high.

I had hoped to find in picric acid a means of separating the different hydrocarbons, but, as I have pointed out before, although the whole series forms picrates, the compounds are so little stable, and we cannot separate them with sufficient accuracy, that an analytical method is not likely to result from the use of this acid.

At present, then, we must confess the want of an absolutely true quantitative laboratory test, and I am not very sanguine of complete success in this direction. I may compare the difficulties we have to encounter wi

those met with in the determination of the alkaloids in cinchona bark ; here also we have a whole series of compounds, extremely similar to each other in their chemical and physical behaviour ; here also we have one member of the series, the quinine, prominently standing out ; and although the subject has been studied for many years, and although several methods have been proposed and are followed out, we must confess none of these methods give entirely satisfactory and reliable results.

But if chemical science is at fault here, let the manufacturer make use of it, when it can assist him, in the improvement of his crude material ; let him produce an article of high percentage, and he will thereby best assist himself in removing the difficulties in the valuation of his product.

(To be continued).

LECTURES ON CRYSTALLOGRAPHY
AT THE
CHEMICAL SOCIETY, BURLINGTON HOUSE.

PROFESSOR MASKELYNE has offered to give a short course of lectures on crystallography to those members of the Chemical Society who may be desirous of studying this subject. It is proposed, if a sufficient number of members intimate their intention of attending, that the lectures be delivered on Mondays and and Fridays, at 8.30 P.M., during the months of November, December, and January, commencing on the 23rd inst. Professor Maskelyne hopes it will be understood that gentlemen attending these lectures will be prepared to devote some of their leisure to working at the subject, in the manner to be indicated by the lecturer. Crystallography cannot be studied without geometrical reasoning, but it will be Mr. Maskelyne's endeavour to treat his subject with as small an amount of mathematical detail as is consistent with its due development. The lectures will be open to any one introduced by a Fellow of the Chemical Society. It is particularly requested that members intending to attend these lectures will communicate their intention, previously to the 20th inst., to Dr. Russell, Chemical Laboratory, St. Bartholomew's Hospital, E.C.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.
Thursday, November 4th, 1874.

Professor ODLING, F.R.S., President, in the Chair.

AFTER the visitors had been announced, and the minutes of the previous meeting read and confirmed, Messrs. C. Armbruster, G. Christopher, W. H. Carter, J. H. Davies, and W. Pierce, Jun., were formally admitted Fellows of the Society. The names read for the first time were those of Messrs. E. Woodhead, T. Harrison, A. L. Sparkes, D. Kingsford, W. H. Griffith, E. W. Parnell, R. Hedderwick Ker, W. R. Hodgkinson, G. W. Slatter, W. Hargreaves, A. Deck, J. E. Morris, Roland H. Ridout, W. Payne, W. Griffin, and D. C. Mackenzie. For the third time—Messrs. Edwin Rider Cook, John Cox, and Henry John Cook, who were balloted for and duly elected.

The first paper, " *On Methyl-Hexyl Carbinol,*" by C. SCHORLEMMER, F.R.S., was then read by the Secretary. From previous experiments on the methyl-hexyl carbinol, obtained by distilling castor-oil soap with soda, the author expected that the alcohol would yield normal caproic acid on oxidation. The purified alcohol boiled at 177° to 178° C., and the caproic acid prepared from it boiled at 204° to 206°. The calcium and barium salts corresponded exactly in composition and properties with those described by Lieben and Rossi. The octane, however, obtained from methyl-hexyl carbinol does not yield a trace of acetic acid on oxidation, this differing from the other normal paraffins in this respect.

The PRESIDENT said the thanks of the Society were due to Dr. Schorlemmer for this interesting paper in relation to the subject which he had done so much to elucidate.

Mr. NEISON said the results of Dr. Schorlemmer agreed with those he had obtained, except in one point. He had found it impossible to purify the alcohol completely by fractional distillation and treatment with sodium bisulphite. It then boiled at 177° to 178°, but always contained traces of the ketone, which could be separated. on converting the alcohol into the octylene boiling at 125° C., by treatment with zincic chloride. By repeated distillation from caustic soda, however, the alcohol could be obtained in a pure state, and it then boiled at 182° to 183° C.

Dr. ARMSTRONG thought the chief interest of the paper was that the alcohol was proved to yield normal caproic acid, as it well illustrated the great advantage of a comparison of the physical properties in ascertaining the nature of such compounds.

The next paper, " *On the Action of Organic Acids and their Anhydrides on the Natural Alkaloids* " (Part 1), was read by the author, Dr. C. R. A. WRIGHT. By long digestion of dry codeine with glacial acetic acid or with acetic anhydride, it is converted into the crystalline diacetyl-codeine, $C_{36}H_{40}(C_2H_3O)_2N_2O_6$, which is soluble in benzine, chloroform, and boiling-water. The base yields a crystalline hydrochloride. The action of glacial acetic acid on morphine gives rise to the formation of α-diacetyl-morphine, $C_{34}H_{36}(C_2H_3O)_2N_2O_6$, which can, with difficulty, be obtained in the crystalline state ; the hydrochloride, however, crystallises readily. With excess of acetic anhydride, morphine forms tetracetyl-morphine, which crystallises readily, and is soluble in ether, alcohol, and benzine. Its hydrochloride is excessively soluble in water. At the same time as the tetracetyl compound, α-diacetyl-morphine is produced. When the acetic anhydride is not in excess, three distinct diacetyl-morphines appear to be produced, the β compound being the principal product. With a small quantity of acetic anhydride, monacetyl-morphine is obtained. All these compounds are more or less readily decomposed by the action of boiling-water into the original base and acetic acid. The physiological action of these new bases has been examined by Dr. Pierce, who finds that it is nearly the same as that of deoxy-morphine and deoxy-codeine.

Dr. ODLING having thanked the author in the name of the Society, a paper " *On the Action of Bromine in the Presence of Water on Bromo-Pyrogallol and on Bromo-Pyrocatechin,*" by Dr. J. STENHOUSE, F.R.S., was read. The author finds that, although dry tribromo-pyrogallol is not acted on by dry bromine, yet the mixture, when dissolved in water and gently heated, deposits a new compound in brilliant yellow scales, having the formula $C_{18}H_4Br_{14}O_6$. *Xanthogallol* is insoluble in water, but readily soluble in benzine and in ether. Its solution in the latter, when agitated with a solution of sodium carbonate, is decomposed, with formation of the sodium compound of a new substance which separates in pale yellow scales. These, when decomposed with dilute sulphuric acid, yield the new substance in slender colourless needles having the composition $C_{18}H_7Br_{11}O_9$. It is readily soluble in ether and benzine. Bromo-pyrocatechin, when treated with bromine and water, gives rise to *erythro-pyrocatechin*, $C_{18}H_2Br_{10}O$, a compound crystallising in scales of a magnificent dark crimson colour.

The PRESIDENT, in thanking the author, said that the formation of these condensed products was one of great interest ; and, since there was not enough hydrogen in the compound to form hydroxyl with all the oxygen, it was a question how far the latter might be present in the quinone form.

Professor A. H. CHURCH then read a paper " *On the Action of Baryta on Oil of Cloves.*" The author prepared

the pure eugenol from English oil of cloves, and found that the terpene accompanying it boiled at 253·9° C. (cor.). After having been treated with sodium, an oily substance of high boiling-point, and possessing a strong creosotic odour, was also observed. The pure eugenol, when mixed with basic oxide and powdered zinc, and destructively distilled, yields from 10 to 15 per cent of an oil which, after purification, boiled at 263·5° C. (cor.). It has the composition expressed by the formula $C_{11}H_{14}O_2$, or that of methyl-eugenol. This compound, however, as obtained by the action of sodium-eugenol on methyl-iodide, boils at 237° C., so that the new compound would appear to be isomeric with methyl-eugenol. By oxidation, it yields dimethoxybenzoic acid, $C_9H_{10}O_4$, melting at 179·5° C.

Dr. ODLING said the Society was much indebted to Professor Church. The formation of methyl-eugenol in this way was of considerable theoretical interest.

"*Observations on the Use of Permanganate of Potash in Volumetric Analysis, and on the Estimation of Iron in Iron Ores,*" by E. A. PARNELL, was then read by the Secretary. The author draws attention to the fact that, in determinations of iron by potassium permanganate, when the former is in the state of ferrous chloride, the colour of the ferric chloride produced interferes considerably with the determination of the exact point of peroxidation. By employing artificial light, however, this difficulty may, in a great measure, be obviated, and the method possesses the great advantage over that with potassium dichromate, that zinc may be used as the reducing agent instead of sulphurous acid. The author prefers arsenious acid for standardising the permanganate solution, and gives minute details of the best method of effecting this.

The PRESIDENT thanked the author for his paper, which contained so many practical hints.

The last paper was entitled "*Further Researches on Bilirubin and its Compounds,*" by Dr. J. L. W. THUDICHUM. The author finds that bilirubin, $C_9H_9NO_2$, absorbs bromine vapour, and acquires a violet colour and golden lustre. The product appears to consist of dibromo-bilirubin, $C_9H_7Br_2NO_2$. It is soluble in alcohol, with an intense violet colour. With chlorine, a tetrachloro-bilirubin, $C_9H_5Cl_4NO_2$, appears to be produced, of a greenish yellow colour. Bilirubin absorbs nitrous acid, but no definite compound could be obtained. This paper also contains experiments on the alleged transformation of bilirubin into the colouring matter of urine.

The thanks of the Society having been given to the author, the meeting was adjourned until Thursday, November 19th, when the following papers will be read :—

(1). "On the Action of Organic Acids and their Anhydrides on the Natural Alkaloids" (Part II.), by G. H. Beckets and C. R. A. Wright, D.Sc. (2). "On the General Equations of Chemical Reactions," by W. K. Clifford, F.R.S. (3). "On Propionic Coumarin and some of its Derivatives," by W. H. Perkin, F.R.S.

The PRESIDENT announced that Professor Maskelyne had offered to give a short course of lectures " On Crystallography " to those members of the Chemical Society and their friends who may be desirous of studying this subject. If a sufficient number of members intimate their intention of attending these lectures to Dr. Russell, F.R.S., of St. Bartholomew's Hospital, they will be delivered on Monday and Friday evenings at Burlington House, at 8.30, during the months of November, December, and January, commencing on the 23rd inst.

CORRESPONDENCE.

THE PRESENCE OF FERROUS SULPHIDE IN CHAR.

To the Editor of the Chemical News.

SIR,—I beg to acknowledge how much the contents of your issue of the 9th of October interested me. One article especially claimed my attention, that by Mr. R. Frazer Smith, F.C.S., " On the Presence of Ferrous Sulphide in Bone-Char."

The chemistry of this substance is very important, and it must not be subject of wonderment that sugar refiners have devoted much attention to it, or that chemical knowledge should so frequently be sought after. They properly conclude that only the experienced chemist can be successful in its manipulation ; and so thoroughly are they impressed with the advantages to be derived from *accurate* analysis of their sugars, chars, &c., that they invariably try to procure them. Some of the more indifferent sugar refiners neglect such assistance until landed in some difficulty, but, all things being equal as regards buying and selling, they cannot be said to hold that position of advantage which their more fortunate rival possesses. The correct chemical analysis of bone-char is, perhaps, one of the most difficult things in analytical chemistry ; the experiments require particular caution to guard against error, and, above all, the process is highly facilitated by a close technical knowledge of the different processes involved in the sugar manufacture. Without such supplementary knowledge, I am inclined to think that the chemist is hardly in a position to construe his results in a manner useful to sugar refiners.

Considering these observations, and the manner in which they are made, I think I may fairly conclude that your correspondent's experience must have been derived from samples of bone-char so unlike those usually known to sugar refiners, as to render the information which he has given in the article referred to of very little avail to gentlemen like Mr. Speir and myself possessing an enlarged experience in the sugar refiners' art. It is very kind of him to improve a few chemists in their studies into the chemistry of this substance, and the shade of dogmatism which he throws over his communication I will allow him on that basis.

I desire to deal with a few of Mr. Smith's statements, *none* of which are new to me.

(1). Mr. R. Frazer Smith, F.C.S., at the very first sentence of his communication, commits himself when he asserts that " *all* chemists usually state the total sulphur in char as calcic sulph*ate*." In my humble opinion, this is saying too much. How can he take it upon him to tell your readers, through the medium of your columns, what all chemists do when they have occasion to analyse bone-char ?

(2). Mr. R. Frazer Smith, F.C.S., claims the honour of discovering a ferrous sulphide in bone-char. Such are his statements, and he has advanced the " Yes " to them as positively as one can do. I think I possess sufficient facts and material to advance the " No " to them all.

It is asserted that " all chemists usually state the total sulphur in char as calcic sulph*ate*," &c. Mr. Smith will pardon me for saying that this very first statement of his in his communication does not embrace a fact. Let him ask Dr. Wallace, of Glasgow, and Mr. Speir, of the Dellingburn Refinery, if ever they overlook the presence of sulphides in bone-char, even when the sample is from an old working stock ? And then let him consult me, and I will tell him that, out of many samples of bone-char which I have had occasion to analyse, I never once remember having overlooked the presence of these sulphides.

Why, Sir, this is a statement which I hold there is no justification for. Is your correspondent aware that our position, in overlooking the presence of these sulphides, would be at stake were we to do so ? No, the fact is, Mr. Smith does not know the abilities of some of the most intelligent chemists connected with the Clyde sugar works. Indeed, the importance of the work which is usually entrusted to me, and the moral obligations which I am under to my employer to return accurate analyses of the many samples of bone-char submitted to me, will on no account cause me to overlook their presence. And I am glad to state that I do know it to be a fact that Dr. Wallace, of Glasgow, seldom fails   notice the presence of these

sulphides, simply for the same reasons which I havespecified; but—
　　　　　"Facts are chiels that'll no ding."
and I think I have advanced sufficient facts to prove that "all chemists *do not* usually state the total sulphur in char as calcic sulph*ate*," even when the sample is from an old working stock.

Sir, Mr. Smith's paper contains nothing original to me. I considered nearly three years ago, when studying the chemistry of sugar in the laboratory of Messrs. Wallace, Tatlock, and Clark, at Glasgow, that I had *proved* (not supposed), without a doubt, that a ferrous sulphide did exist to a small extent in some particular samples of bone-char, the very thing which your correspondent now attempts to communicate to your columns as a piece of original research. I think that, after Mr. Speir has confirmed *my* discovery by his investigations, conducted some two years ago, it must be patent to most readers of the CHEMICAL NEWS that Mr. Smith is far behind in the march of original research into the chemistry of animal charcoal, particularly when he is *only now* observing facts discovered by Mr. Speir and myself *long ago.*

Mr. Speir is quite correct; the presence of ferrous sulphide is a fact well-known to most of the experienced chemists connected with the Clyde sugar works; and, further, I do know myself of *three* distinct individuals who were aware of its presence at least two years ago.

There are a few points connected with Mr. Smith's annexed analysis which I refrain from touching upon.—I am, &c.,

　　　　　　　　J. COMBE STEWART, F.C.S.

Cappielow Sugar Refinery, Cartsdyke, by Greenock,
　　　　　November 6, 1874.

THE PRESENCE OF FERROUS SULPHIDE IN CHAR.

To the Editor of the Chemical News.

SIR,—On page 217 of the CHEMICAL NEWS I observe a letter from Mr. Smith, in reply to my former letter. In it he asserts that the whole of the experiments contained in his papers were his own. This I must most emphatically deny. Experiments 1 and 2 of his paper (the only ones which in my opinion go to prove the presence of ferrous sulphide in char) were carried out by Mr. Smith and myself on his coming into the employment of Messrs. Blair, Reid, and Steele. At that time Mr. Robert Frazer Smith was totally ignorant of animal charcoal, or its nature, and had not even made an analysis of it. The experiments referred to were carried out by him and me during the very first days in which he was in Blair, Reid, and Steele's laboratory, and before even an analysis of char had been made by him. The laboratory journal of Blair, Reid, and Steele is proof of this fact. I ask if any sane man could assert that Mr. Smith, knowing previously nothing whatever of charcoal, was likely to originate experiments to prove the presence of ferrous sulphide before he had made even an analysis of the substance under consideration. Even supposing that all the experiments had been originated by him, it would, under the circumstances, have been extremely uncourteous to have acted as he did; as it is, it is something more.

I annex a copy of a letter to me from Dr. Wallace, with an extract from a letter from him to Blair, Reid, and Steele (Mr. Smith's employers), of which Mr. Smith was well aware, but, through some defect in his memory, no doubt omitted to mention.—I am, &c.,

　　　　　　　　　　　　R. SPEIR.

Greenock, Nov. 10, 1874.

(COPY)
　　　Chemical Laboratory, 138, Bath Street,
　　　　　Glasgow, 27th Oct., 1874.

MR. ROBERT SPEIR,—My dear Sir,—The letter you refer to is addressed to Messrs. Blair, Reid, and Steele, and

dated 23rd March, 1874. It treats of various matters, amongst others of the FeS in charcoal. I give an extract below. I was under the impression that it was you who suggested the presence of FeS in charcoal—but no matter, so far as I am concerned, Mr. Smith is welcome to any credit he may think he has by his paper.—Yours faithfully,

　　　　　　　　　　WM. WALLACE.

Extract from letter to Blair, Reid, and Steele referred to :—
" The incrustation of metallic-looking substance in the interior of the pipe contains—

Sulphur	35·95
Iron	58·80
Other things, not estimated ..	5·25
	100·00

" It consists, therefore, essentially, of protosulphide of iron, and dissolves very freely in acids, with formation of sulphuretted hydrogen. In analysis of charcoal it is the invariable custom to state the iron in the condition of oxide, but I have long been of opinion that it exists wholly, or in part, as sulphide, and the occurrence of this incrustation, which I have never observed before, serves to confirm this opinion. It would be interesting to ascertain at what part of the pipes this sulphide of iron is formed. If, as I believe, it is a direct result of overheating the charcoal, it will be found only at that portion of the pipe where the flame strikes, and chiefly in the pipes of the front row."

DOUBTFUL MINERALS.

To the Editor of the Chemical News.

SIR,—As a curiosity in criticism, whether from a literary, æsthetic, or scientific point of view, the communication in the CHEMICAL NEWS, No. 775, p. 164, signed T. A. R., is possibly unique. Since one part is at any rate intelligible, and since a mineral of my describing and naming is included in the dead log of disgusting acquaintances, whose sudden death you are asked kindly to assist at, while inviting your friends to the battue of long enough unhung useless dogs, I beg to inform the writer, who only cares to know whether " the things so named exist at all, or, if so, what they are now called," that the " Cyanolite of *How*," as I described it, exists in the remains of the original specimen mostly in my possession, and that it has, so far as I know, no other name. I may add, though T. A. R. does not want the information, that I have never revisited the locality where I got it, and that I do not know whether any other mineralogist has procured such specimens as I gave an account of in the *Edinburgh New Philosophical Journal*, 1859.

There are doubtless a good many more minerals than those named by T. A. R. not kept in stock by mineral dealers, and I dare say some of them are even not to be found in the British Museum.—I am, &c.,

　　　　　　　　　　HENRY HOW.

King's College, Windsor, N.S.
　　Nov. 2, 1874.

ARSENIC FLUORIDE.

To the Editor of the Chemical News.

SIR,—Having observed in your valuable journal (CHEMICAL NEWS, vol. xxx., p. 169) an article by R. W. Emerson Macivor, on " Arsenic Fluoride, I should feel greatly obliged if you can find space for the following remarks on the same subject :—If Mr. Macivor will look up the " Handwörderbuch der reinen und angewandten Chemie," vol. ii., p. 244, edition for 1858, he will find the arsenic fluoride described much more fully than in his article, all the properties ascribed to it by Mr. Macivor being given. I merely mention this fact, as Mr. Macivor seems to

imagine he has conferred some benefit to the Science of Chemistry by re-describing a well-known compound without explaining anything new about it.—I am, &c.,

M. N. C.

Tübingen, November 2, 1874.

THE ANALYSIS OF PHOSPHATES, &c.

To the Editor of the Chemical News.

SIR,—It will probably interest your correspondent of the 30th ult., and other readers of the CHEMICAL NEWS, to learn that at the recent meeting of the British Association, at Belfast, a Committee—consisting of Messrs. E. C. Stanford, E. Dewar, A. Fletcher, and myself as Secretary (with power to add to our number)—was appointed to report on the methods employed in the analysis of phosphates and of potash-salts, and on the best mode of stating the results.

With regard to phosphates, the intention of the Committee is to ascertain, by inquiry, what methods are in use, and to learn the opinions of the chemists using them as to their special advantages and limits of error, and then either to apply for a further grant (the present one being almost nominal), with the view of rigidly testing the accuracy of one or two processes, or at once to recommend one for general adoption.

It seems probable that an accurate and practical process, if officially recommended by a Committee of the British Association, would meet with a very general adoption among chemists, and that a "B.A. method" would be welcomed by both buyers and sellers as a perfectly neutral standard of reference, while chemists' results would exhibit less variation than is unfortunately the case at present, and the crying scandal of the existence of buyers' and sellers' analysts would die a natural death.

The Committee will very shortly proceed to the collection of data, and will be pleased to receive suggestions from all interested in the objects aimed at. Any communications addressed to me as Secretary will of course receive the attention of the Committee.—I am, &c.,

ALFRED H. ALLEN.

1, Surrey Street, Sheffield.

BUTTER: ITS ANALYSIS AND ADULTERATIONS.

To the Editor of the Chemical News.

SIR,—In your journal (CHEMICAL NEWS, vol. xxx., p. 174) you had the kindness to publish a short review of our little book on "Butter." As this review contains several inaccuracies, which greatly tend to diminish the value of our method for detecting and estimating foreign fats in butter, we trust that you will permit us to correct them.

Our method does not consist in the distillation of the butter soap with dilute sulphuric acid, and the estimation of the acidity of the distillate, but in the estimation of the *insoluble fatty acids*. The objection you raise against the distillation—namely, that the acidity of the distillate might not only be due to butyric acid, but also to acids produced by the decomposition of the glycerin and the sulphuric acid—we have foreseen, and therefore avoided it. Granted that such decomposition might take place, it is of no practical importance whatever as regards our method. We have found, by many experiments, that the amount of *insoluble* fatty acids in animal fats (except butter) corresponds very closely with the theoretical quantity,—namely, 95·5 per cent,—while butter yields never more than 86·2 per cent. The difference between the quantity of fatty acids found in butter and that found in other fats, is, on an average, 9·65 per cent, and we conclude that it must be due to soluble acids. But supposing this inference to be erroneous, the facts remain the same, and are equally available for the estimation of foreign fats

when mixed with butter. Mr. Wanklyn suggests that butter might possibly contain mono- or di-olein, &c., which would equally well explain the difference. We must, however, emphatically contradict his statement, that it is not possible to obtain by distillation more than 0·1 per cent of volatile acids from butter. The smell alone can convince him of the contrary: 3 grms. of butter, saponified, and decomposed with sulphuric acid, emit such a powerful smell that it is hardly possible to remain in the room. According to him this smell is due to 3 milligrms. of volatile acids.—We are, &c.,

ARTHUR ANGELL, F.R.M.S.
OTTO HEHNER.

Southampton, October 12, 1874.

[Nothing could be further from our intentions than to give any annoyance to the authors, or to depreciate the legitimate value of their method. They certainly, however, fail to point out the "several inaccuracies" of which they accuse us. In their book they state that they had recourse to the indirect estimation of the volatile acids because they found it "impossible to obtain the *whole amount present* by distillation." In the above letter, on the contrary, they tell us that they foresaw our objection, and therefore avoided the direct process. Now, as our "objection" was a request for proof as to the nature of the distillate,—in default of which the volatile acids may possibly be *less* than the amount thus formed,—the above two statements seem to us contradictory. Not having quoted Mr. Wanklyn in our notice of the work we feel disposed to question the relevancy of introducing his name on this occasion. We do not undervalue the nose as an instrument of preliminary qualitative research, but somewhat distrust its quantitative indications.—ED. C. N.]

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 13, September 28, 1874.

This number is entirely occupied with the discourses delivered in honour of Elie de Beaumont, late one of the perpetual secretaries.

No. 15, October 12, 1874.

Critical Observations on the Use of the Tincture or the Powder of Guaiacum to Ascertain the Purity of Kirschenwasser.—M. Boussingault.—The blue colouration, on the addition of guaiacum, relied on as a mark of purity, is common to every alcoholic liquor containing copper.

Relation Between the Real Ash and the Sulphated Ash in the Products of the Sugar Manufacture.—Ch. Violette.—In the method of commercial analysis, used in determining the value of sugars, it is admitted that 0·9 of the weight of the sulphated ash represents approximately the weight of the true ash, *i.e.*, that which would be found by the direct incineration of the sample without the addition of acid. In a memoir on crude sugars (*Comptes Rendus*, lxxxvi., 642) the author has shown that this coefficient is too high: 0·8 is much more correct for raw sugars, and for very pure samples it does not exceed 0·7.

Communication on the Destruction of the Phylloxera.

New Experiments on the Alkaline Hydrosulphates for the Destruction of the Phylloxera.—M. Mouill-Fert.

Action of Coal-Tar in the Treatment of Vines Attacked by the Phylloxera.—M. Balbiani.

Employment of Electro-Diapasons of Variable Periods as Tonometers and Electro-Interruptors. – M. E. Mercadier.—Interruptors of this kind have a decided advantage over those of Foucault. They are, at will, either single or double acting. The two electric systems which produce—the one the maintainance of the vibratory movement of the diapason interruptor, and the other the intermittent currents, are distinctly and clearly separated, which is not the case with Foucault's interruptor.

Attempt at a Theory of the Formation of the Secondary Faces of Crystals.—M. Lecoq de Boisbaudran. —Reserved for insertion in full.

Microscopic Study and Proximate Analysis of a Pumice from Vesuvius. — M. F. Fougué. — This pumice is white, very porous, and floats on the surface of water. It is in pieces about the size of a filbert. To the naked eye it appears homogeneous. With the aid of the microscope it is found to consist of a multitude of crystals of amphigene, united by an amorphous vitreous matter. Crystals of horn-blende, pyroxene, peridote, protoxide of iron, felspar, and brown mica are very thinly scattered through the mass. The granules of amphigene have the following composition ;—

Silica	56·14
Alumina	24·83
Lime	2·91
Potash	8·73
Soda	6·43
	99·04

Sp. gr. 2·41.

2·00 grms. of the pumice contained—

Pyroxene	1·100
Hornblende	0·340
Felspar	0·120
Protoxide of iron.. ..	0·070
Magnesian mica	0·012
Peridote..	0·025

Moniteur Scientifique, du Dr. Quesneville,
October, 1874.

New Helio-Photometer.—F. Craveri.—A box of hard wood, 280 m.m. long, 145 m.m. wide, and 200 high, forms a parallelopiped placed upon a pedestal in an open situation, where nothing impedes the direct action of the sun. The upper surface of the apparatus cannot preserve, during the twelve months of the year, a horizontal position, because when the sun sinks below the equator in winter its rays would fall too obliquely. It is therefore necessary at that season to follow approximately the movement of the sun. This result is obtained by gradually inclining the instrument towards the south from September to December, and gradually diminishing the inclination again till March, when it is replaced in a horizontal position. One of the principal sides of the parallelogram represents the door, fixed on hinges, and giving access to all the interior. At the side opposite the door is fixed a clock, the dial of which is seen through a circular aperture in the side. To this clock is adapted a toothed wheel, moved by the drum containing the spring. This wheel only performs one revolution in twenty-four hours. To its axle is fixed by a movable screw a large drum of brass, the circumference of which is 520 m.m., and the breadth 16 m.m. Upon the surface of this drum is fixed a slip of paper, as is done with the Morse telegraphs. A few seconds are sufficient for fixing or for removing this band. A slit in the box is so arranged that the sun's rays, shining through it, fall upon the band, even when the luminary is very near the visible horizon. The bands are repared with chloride of silver by being steeped first in a solution of common salt, and then, shortly before being used, in solution of nitrate of silver.

A series of papers from the Laboratory of the Polytechnicum, at Zurich, contain an account of the kawa root, by MM. Mölting and Kopp ; a paper by MM. Bibanow on the reactions obtained on melting together certain compounds of aniline and toluydin. The authors have formed magenta by melting together 20 grms. of nitranilin, 40 grms. pseudo-toluydin, and 5 grms. of aniline. The quality of the colouring matter obtained was good, but the yield was small. The same authors give an account of a double chloride of toluydin and zinc, $ZnCl_2 + 2(C_7H_9NHCl)$.

Barytes Green or Manganate of Baryta. — E. Fleischer.—This salt has been introduced into commerce under the names of Cassel green or Rosenstiehl's green. It has generally been prepared by calcining nitrate of baryta with oxide or peroxide of manganese, or by fusing caustic baryta with manganese and chlorate of potash. The author gives a new method for its preparation. On precipitating a green boiling solution of manganate of potash with chloride of barium, there is formed a deposit, strongly granular, but not crystalline. This precipitate is of a violet colour, bordering on blue. It is well washed by decantation, and then filtered. When dried its colour becomes paler as the temperature rises. At a dark red heat is white, with a slight greyish blue tinge. If heated higher, with access of air, it becomes by degrees completely green, then of a fine blue, and at very elevated temperatures it is converted into a dirty brown grey. If a solution of permanganate of potash is precipitated with chloride of barium, and allowed to boil, there is slowly formed a reddish violet deposit (colour of peach blossom), and the liquid retains an intense violet colour. The precipitate may be washed by decantation, and filtered without decomposition. It can even be dried at 100° without losing its colour. When gradually heated the permanganate of baryta loses its colour like the manganate. but at very high temperatures it behaves differently. When its colour has once been destroyed by a moderate heat it does not become either green or blue by further heating with access of air. The whole becomes at once of a greyish brown. The finest barytes green is formed by calcining the manganate of baryta. Rosenstiehl's process—the fusion of hydrate of baryta with chlorate of potash and peroxide of manganese—yields an inferior colour.

Garnet (or Grenade), a New Dye.—This substance has been introduced as a substitute for orchil. It is perfectly soluble in water, and if used alone produces garnet-browns of great purity. In combination with extract of indigo, turmeric, &c., it may be made to yield every shade of brown with a brightness which orchil cannot equal.

Manufacture of Soda by the Ammonia Process.— Dr. List.—Reserved for insertion in full.

Determination and Assay of Sulphuric Acid.—A. G. Pouchet.—To determine the nitrous compounds in commercial sulphuric acid we take 100 c.c. of the sample, and add to it by means of a burette normal permanganate (1 c.c. = 0·005 grm. pure iron) until a faint permanent rose colour is produced. This operation converts the lower oxides of nitrogen into nitric acid, and sulphurous acid, if present, into sulphuric acid. On the other hand, put in a flask containing 500 c.c., 10 c.c. of a solution of sulphate of protoxide of iron, containing 0·1 grm. of iron. Add the 100 c.c. of the acid previously treated with manganese, and rinse the vessel which had contained it into the flask. Boil, when the nitric acid peroxides a part of the iron, and is reduced to NO_2, which escapes. After boiling for half-an-hour pour into the flask water, previously boiled, enough to fill it three-quarters full, stopper, and let cool. When perfectly cold, titrate with normal permanganate till the faint permanent rose tint appears, noting the quantity of permanate required, whence the amount of nitric acid in the sulphuric acid may be readily calculated. Kolb recommends the following process to

determine the nitrous acid in the Gay-Lussac column :—1 grm. of pure dry permanganate corresponds to 0·6 grm. NO_3, and converts it into 0·85 grm. NO_5. The permanganate must not be dropped into the acid, but the acid under examination must be dropped into a known volume of permanganate until the latter is decolourised. Cold dilute nitric acid has no action upon permanganate. Kolb operates upon 0·5 grm. of permanganate in solution, and the volume of acid employed to decolourise it shows the amount of nitrous acid contained. To the liquid is now added a known volume of the normal solution of iron, and the whole is boiled to expel NO_2. Dilute with boiled water, stopper the flask, and when completely cool titrate with normal permanganate. We obtain thus an amount of nitric acid, from which it is necessary to deduct that furnished by the former operation, and which has been calculated into nitric acid. The difference shows the real quantity of nitric acid existing in the volume of liquid used in the first place to decolourise the 0·5 grm. of permanganate. Suppose, for example, that it was needful to use 10 c.c. of the sample of acid to decolourise the 0·5 grm. of permanganate. These 10 c.c. contain 0·300 grm. of NO_3. If, in the second place, it is found by means of the normal solution of iron that the same 10 c.c. of acid contain 0·572 of NO_3, from this quantity we must deduct 0·425 the equivalent in NO_5 of the 0·300 of NO_3. There remains 0·147 of NO_5 for the 10 c.c. of acid operated upon, or in 100 parts—

Nitrous acid .. .. .. 3·00
Nitric acid .. .. .. 1·47

On Ultramarine.—B. Unger.—This paper is too long for insertion.

Liebig's Annalen der Chemie und Pharmacie.
August 29, 1874.

Communications from the Laboratory of the University of Kiel.—These communications consist of a paper by E. Demole on the preparation of glycol; another by the same author on the aromatic hydroxethylen-amines; and one by A. Ladenburg on certain new organic compounds of silicon.

Processes during Incomplete Combustion of Coal-Gas, and on its Behaviour when Heated in the Absence of Air.—R. Blochmann.—As a type of the combustion of coal-gas with an insufficient supply of oxygen, the author takes the flame of a Bunsen burner when it strikes down into the tube. He finds that acetylen is formed by this flame as well as when coal-gas is heated in the absence of air. Hydrogen, marsh-gas, and the other constituents of coal-gas, do not prevent a polymeric condensation of the acetylen formed from the heavy hydrocarbons when gas is heated in the absence of air. The acetylen generated by the "striking back" of a Bunsen flame appears, however, chiefly in a free state.

Dimethyl-Isobutyl-Carbinol, and on the Heptylen obtained therefrom.—D. Pawlow.—This new tertiary alcohol is formed by the action of chloride of valeryl on zinc methyl. It distils over at 129° to 131°. It is a light colourless liquid, almost insoluble in water, of strong camphor-like odour, resembling that of the other tertiary alcohols, and of a burning taste. At —20° it does not congeal but becomes ropy. Its formula is $C_7H_{16}O$. If the iodide of this body is decomposed with alcoholic potash it yields a new heptylen, which boils at 83° to 84°, and has the sp, gr. 0·7144.

On Paramido-Meta-Sulpho-Toluolic Acid.—Dr. H. von Pechmann.—This lengthy paper does not admit of useful abstraction.

Contributions to a More Exact Knowledge of the Starch Group.—Dr. Water Nägeli.—Starch, as we find it in starch granules, consists of a series of modifications, and by means of a further series of such modifications or chemical combinations, it can be finally converted into a kind which takes a yellow colour with iodine, and can be converted into sugar, or split up into two species of sugar. When starch is treated in the cold with different reagents, especially with mineral acids not too concentrated, the part which takes a blue colour with iodine—the blue modification—is extracted, whilst the yellow modification remains behind with the structure of the original granules. The above modifications do not occur in the starch as distinct portions, but are connected by transition stages, which take respectively violet, red, and orange colours with iodine. The yellow modification is the most refractory. It is insoluble in water, and is least easily affected by boiling therein, or by treatment with acids. Its most extreme form, which seems closely related to, or perhaps identical with, cellulose, is almost incapable of being attacked. The most refractory portion forms the capsules or envelopes of the starch grains. The more we approach the blue modification the more soluble and decomposable the substance becomes, its affinity for iodine increasing simultaneously.

Researches on the Source of the Acid in the Gastric Juice.—R. Maly.—The author finds that the pure gastric juice in dogs contains no lactic acid. The decomposition of chlorides by lactic acid cannot, therefore, be the source of the hydrochloric acid in the stomach. Lactic acid seems to play no part in the chemistry of the normal formation of acids. The source of the free hydrochloric acid in the stomach is a process of dissociation of the chlorides without the action of an acid.

Contributions to the Knowledge of Chloral.—O. Wallach.—The author examines, first, the action of aromatic amides on chloral, making especial mention of the behaviour of the latter with anilin, toluydin, and xylidin; secondly, the behaviour of chloral and amidic acids; then of chloral and the salts of aromatic acids; and, lastly, the behaviour of chloral with nitrous acid.

Action of Cyanide of Potassium upon Chlorinised Aldehyds.—O. Wallach. —Not suitable for abstraction.

Meta-Chlorphenol, and its Nitro Derivatives.—A. Faust and H. Müller.—Taken from *Berichte*, v., 777.

Correction of Former Statements Concerning Chloro-Nitrophenols.—A. Faust.—See *Annalen*, supplement vii., 192.

Isononylamid and Isononylic Acid.—H. A. Kullhem.—The author obtained isononylamid, $C_9H_{19}NO$, by setting out from caprylic alcohol. Isononylic acid, $C_9H_{19}O_2$, is almost insoluble in water, readily soluble in ether and alcohol. Its boiling-point is 244° to 246° at 760 m.m. barometric pressure. It does not solidify at —11°. Its sp. gr. at 18° C. is 0·90325. The author describes its soda, potash, ammonia, lime, copper, and silver salts.

Meta-Chlorphenol, and its Mono-Sulpho Acid Derivatives.—J. G. Kramers.—The author has examined γ-chlorphenol-sulphuric acid, and a number of its salts; and δ-chlorphenol-sulphuric acid, and its potash and lime salts.

New Compound from Urine.—F. Baumstark.—The substance in question, $C_3H_8N_2O$, has a strong resemblance to hippuric acid. It forms white columns of several millimetres in length. Freely soluble in boiling water; sparingly in cold water and spirit of wine; insoluble in absolute alcohol and ether. If heated to 250° the crystals experience no change. If more strongly heated they decrepitate, evolve dense white vapours of a peculiar odour, fuse, and finally burn with the odour of horn. It is neutral to test-paper, does not combine with bases, but forms with acids salts which do not readily crystallise and deliquesce on exposure to the air.

Trimethyl-Acetic Acid.—A. Butlerow.—An account of the chemical and physical properties of this acid, and of a number of its salts.

MISCELLANEOUS.

The Royal Society.—The medals in the gift of the Royal Society for the present year have been awarded by the Council as follows, and will be presented at the anniversary meeting of the Society on the 30th inst. :—The Copley Medal to Professor Louis Pasteur, of the Academy of Sciences, Paris, For. Mem. R.S., for his researches on fermentation, &c. The Rumford Medal to Mr. J. Norman Lockyer, F.R.S., for his spectroscopic researches on the sun and on the chemical elements. A Royal Medal to Professor William Crawford Williamson, F.R.S., of Owens College, Manchester, for his contributions to zoology and palæontology, and especially for his investigations into the structure of the fossil plants of the coal measures ; and a Royal Medal to Mr. Henry Clifton Sorby, F.R.S., for his researches on slaty cleavage, and on the minute structure of minerals and rocks, for the construction of the micro-spectroscope, and for his researches on colouring matters.

University of London.—The following is a list of the candidates who passed the recent Second B.Sc. Examination :—*Pass List.*—(First Division)—F. H. Barling, Owens College ; F. D. Brown, private study ; S. A. Hill, Royal Scoool of Mines ; J. N. Keynes, B.A., Univ. and Pembr. Camb. Colleges ; J. G. MacGregor, Edinburgh University ; A. H. Spokes, B.A., University College ; A. T. Wilkinson, B.A., Owens College School of Medicine. (Second Division)—F. W. Aveling, M.A., University and New Colleges ; P. P. Bedson, Owens College ; E. B. Cumberland, private study ; G. S. Dunn, B.A., private study ; J. Fewings, B.A., Queen Elizabeth's Hospital and private study ; W. H. Munns, B.A., University College ; P. K. Ráy, University and Manchester New Colleges, and Royal School of Mines ; A. H. S. White, B.A., University College ; B. A. Whitelegge, First M.B., University College.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in dyeing, and in apparatus connected therewith. Dan Dawson, aniline manufacturer, Milnes Bridge, and Clayton Slater, cotton spinner, Barnoldswick, York.—February 19, 1874.—No. 633. This invention consists in the use of improved means and apparatus for dyeing and "fixing" the dye or colouring matter upon fabrics of cotton or other vegetable fibre or fabrics composed partly of cotton or other vegetable fibre, and partly of wool and other animal fibre, by passing same through the dye-liquor, and then through ammoniacal vapour, and in the apparatus connected therewith.

Improvements in the distillation of essential oils or perfumes. Alphonse Piver, perfumery manufacturer, Boulevart de Strasbourg, Paris. February 19, 1874.—No. 634. This invention relates to a process of distilling aromatic substances at a temperature higher than the boiling-point, that is to say, a pressure of between 1 and 5 atmospheres. The apparatus used consists of a steam generator, a closed vessel to contain the aromatic substances, a cooler or condensing chamber, a vessel divided into compartments by vertical partitions, and intended for regulating the flow of the liquid, and an apparatus for preventing overflow in case of sudden increase of heat. Steam from water or alcohol passes from the boiler into the vessel containing the aromatic substances, and thence, laden with perfume, to a worm in the condensing chamber, whence it runs into the vessel for regulating the flow, passing successively up and down its compartments, a small quantity of essential oil being separated at the top of each compartment and falling into a bottle, the water flowing into another vessel. In case of a sudden rush of liquid the irruptive flow falls into a swing box which brings a funnel under the outlet of the tube of the condenser, and the liquid is conveyed into an open vessel placed under the said swing box.

Improvements in the manufacture of sugar, and in purifying saccharine solutions. John Stenhouse, analytical chemist, Rodney Street, Pentonville, Middlesex. February 20, 1874.—No. 652. The essential features of this invention consists in effecting the removal of lime, existing either as saccharate of lime or otherwise, from solutions of sugar or other saccharine solutions, by means of oxalic acid, or by means of the oxalates of ammonia, potash, or soda, or mixtures of the same.

Improvements in the treatment of sewage, and in the manufacture of manures therefrom. Major-General Henry Young Darracott Scott, C.B., Ealing, Middlesex. February 20, 1874.—No. 653. The object of this invention is the preparation, from the sewage of towns by cleanly and inoffensive processes, of manures suitable to the wants of the farmer as respects their richness in fertilising elements, and also their price and quality.

Improvements in the manufacture of artificial butter. Edward Griffith Brewer, Chancery Lane, Middlesex. (A communication from E. Diderichsen, Copenhagen, Denmark.) February 21, 1874.—No. 661. This consists in making butter from tallow or other fatty matter. It is washed in cold water, cut into pieces, and melted by steam in a wood vessel. Acid soda is subsequently added, and the material boiled several times, adding soda, and finally in pure water; then sifted through flannel, and afterwards churned, fine oil and sour milk being added during the latter process.

Improvements in the extraction of oleaginous matters from woolwashing suds, or other liquids containing soapy matters or grease, and the production of tallow or oil from the resulting substances. Henry Benjamin, Graham's Town, South Africa. February 23, 1874. No. 682. The features of my invention are in the extraction of grease or fatty matters from wool-washing suds, and converting the same into tallow, soap, oil, and such like articles.

A new or improved method of manufacturing artificial butter, and of clarifying or purifying rancid butter. Daniel Hipkins, Tipton, Stafford. February 23, 1874.—No. 684. This invention consists—(1) in making artificial butter by melting fat by means of steam or hot water. The fat is then drawn off and allowed to cool. It is then raised in temperature, and the olein or softer part is removed by pressure from the stearin or waxy part. The olein is then melted, and suddenly cooled by plunging it into or agitating it in a cold liquid, and it thus loses its rough and granulated consistency, and becomes very similar to butter. (2) In purifying rancid butter by melting it and removing any deposit ; then boiling it with lime-water or other alkali and allowing it to settle ; and, finally, treating the liquor thus clarified by suddenly cooling it in water or other liquid as in the manner first described. The artificial butter, or the clarified butter, may be used separately, or they may be mixed together in any desired proportions, and are perfectly pure and wholesome, and free from deleterious qualities.

Improvements in the construction of furnaces and retorts for the manufacture of bisulphide of carbon. Samuel Henry Johnson, F.C.S., chemist, Lea Bank Works, Stratford, Essex. February 23, 1874.—No. 687. This Provisional Specification describes using a horizontal retort for vapourising the sulphur, and a vertical retort for heating the carbon. Suitable methods of setting the retorts are described.

An improved method of extracting gold from auriferous antimony ores, antimonial compounds, and antimonial mixtures. Tyndall Bright, merchant and ship owner, Liverpool. (A communication from Reginald Bright, merchant, and John Cosmo Newbery, analytical chemist, both of Melbourne, Victoria, Australia.) February 24, 1874. —No. 691. Metallic antimony is fused with ores, compounds, or mixtures, and the gold thereby alloyed with the metallic antimony. The alloy falls to the bottom of the material under treatment, from whence it can easily be removed. When the alloy becomes sufficiently rich in gold—it may be by repeated use—such gold is removed by oxidising the antimony in any of the ways at present known or suitable for the purpose.

A new process for the artificial production of vanilin by means of coniferin, or the sap of plants belonging to the species of conifera, or any other plants related to this family, as an extract of all those parts of the just-mentioned plants containing coniferin. Wilhelm Haarman, Ph.D., analytical chemist, Georgenstrasse, Berlin, Germany. February 25, 1874.—No. 709. Take, first, coniferin ; or, secondly, the sap of plants mentioned above which has been purified or liberated from albumina or other impurities ; or, thirdly, an extract of all those parts of the just-mentioned plants containing coniferin ; or, fourthly, the products obtained from coniferin by means of fermentation, putrefaction, or similar action; and treat one or other with oxidising agents, or such agents of similar action, such as bichromate of potassium and sulphuric acid, or any other peroxide, oxide, acid, or salt, which produce the same effect. The product of the reaction in all these cases is artificial vanillin, which has been proved to be identical in all physical and chemical properties with the aromatic principle obtained by the extraction, &c., of the natural vanilla beans.

Improvements in apparatus for obtaining infusions and decoctions from coffee, herbs, berries, grains, seeds, and leaves. General W. N. Hutchinson, Wellesbourne, near Bideford, Devon. March 2, 1874.—No. 756. Decoctions from coffee are usually made by pouring hot water on the grounds (of the berry) placed in a strainer in an upper vessel, from whence the decoction, when strained, passes into a lower vessel. This arrangement is inconvenient, as under ordinary circumstances it gives such a height to the compound vessel that it cannot stand under the spout of the common breakfast urn, or suspended kettle. It has the further disadvantage that the liquid loses heat in being transferred to the lower cold vessel. Moreover, the compound vessel presents a very large external surface to the cooling influence of the air. The principal object of the present invention is to provide a vessel, whatever may be its material, of so low a shape that coffee can be made in it precisely as tea is usually made. This is effected by placing the filtering vessel *within* the other instead of *above* it, and by forming its sides, and possibly bottom, wholly or partially of a porous quickly-filtrating material or materials. The grains of coffee are placed within the filtrating vessel. Its sides and bottom, which are nearly in close contact with the sides and bottom of the outer vessel, furnish such a large filtrating surface that the hot water which has been added (after standing any required length of time in contact with the grains) will percolate so rapidly through the filtrating vessel as to allow of the liquid being poured out almost as expeditiously as if it were a decoction from tea-leaves made in the usual manner. The pot can be so shaped as to become either a teapot or coffeepot. This method of obtaining decoctions or infusions is applicable to vessels of

large size, when a tap might be employed. It promises to be useful for chemical purposes, because the liquid, without coming to the boiling-point, could be conveniently kept at a regulated temperature with the aid of a lamp.

Improvements in preserving eggs. John Henry Johnson, Llncoln's Inn Fields, Middlesex. (A communication from Dawson Miles, Boston, Mass., U.S.A.) March 2, 1874.—No. 761. This invention relates to an improved mode of preserving eggs, and consists in effecting their condensation by evaporating to a semi-liquid mass, after removing them from the shells, the degree of heat employed being so low as not to prevent them from being afterwards dissolved when required for use; and in the employment of sugar, salt, and sulphite of soda in combination with the eggs.

Improvements in the method of and means for producing electrical signals, and in registering or recording the same. Robert Valentine Dodwell, electrical engineer, Leadenhall Street, London. March 2, 1874.—No. 764. The invention consists in the application and use of a beam or ray of light, suitably prepared by being passed from a battery through an induction coil and vacuum tube, and submitted to the action of an electro-magnet, whereby the ray of light is influenced, and deflections or movements are produced, and signals thereby effected; and in registering or recording such signals upon sensitised surfaces by intensifying the light, and projecting it thereonto by means of a suitable arrangement of lenses.

An improved method of packing or putting-up chloride of lime. William Robert Lake, of the firm of Haseltine, Lake, and Co., patent agents, Southampton Buildings, London. (A communication from Martin Luther Bush, merchant, New York, U.S.A.) March 4, 1874.—No. 799. The object of this invention is to provide a process or method for putting-up chloride of lime; and consists in the manufacture of a specific quantity of chloride of lime enclosed in a kind of waterproof paper or fabric, which is not susceptible to the corrosive ection of the chloride of lime, and which will prevent air or moisturn reaching the same, and hence prevent the escape of the chlorine gas so offensive to the olfactory nerves.

NOTES AND QUERIES.

Oxidising Linseed Oil.—Can any of your correspondents inform me what is the best method of oxidising boiled linseed oil so as to obtain the consolidated oil? Is there any quicker plan than exposure to the air?—B.

Writing Ink—To obtain a good writing ink, dissolve Geigy's soluble aniline black in water. This colour is manufactured by John R. Geigy, Basle, Switzerland, and is much used for that purpose; it can be obtained in this country from W. C. Hood, Walburgh Street, Cable Street, London, E.

Manufacture of Soda.—Being about to investigate the process of manufacturing soda by means of ammonia, I should feel obliged if you will allow me to ask, through your columns, for sources from whence to draw the necessary information. Some papers have, I believe, been published on the subject, but I do not know by whom. If you, or any of your correspondents, would kindly tell me where, and in what works, the process is being carried out, I should feel obliged.—G. C.

MEETINGS FOR THE WEEK.

WEDNESDAY, Nov. 18th.—Society of Arts, 8. Opening Address by Major-General F. Eardley-Wilmot, R.A., F.R.S.
—— Geological, 8.
THURSDAY, 19th.—Chemical, 8. "On the Action of Organic Acids and their Anhydrides on the Natural Alkaloids" (Part II.), by G. H. Beckett and Dr. Wright. "On the General Equations of Chemical Reactions," by W. K. Clifford. "On Propionic Coumarin and some of its Derivatives," by W. H. Perkin. "Action of Bromine on Protocatechuic Acid, Gallic Acid, and Tannin," by Dr. Stenhouse. "On the Composition of Autunite," by A. H. Church.

THE
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Notices of Scientific Works, Progress of the Various Sciences, &c., &c.

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THE CHEMICAL NEWS.

VOL. XXX. No. 782.

CUPROUS CHLORIDE.
By SYDNEY LUPTON.

THE following experiments on the formation of cuprous chloride may be of interest to some of your readers. A solution of crystalline cupric chloride is slightly acid to litmus; if such a solution be boiled upon clean copper, a brown solution of cuprous chloride is gradually formed. When the brown solution is poured into water, a copious white crystalline precipitate of cuprous chloride falls; by prolonged standing under water, the precipitate becomes deep orange, from formation of hydrated and anhydrous cuprous oxide, the water at the same time becoming acid.

If pure copper prepared by electrolysis be boiled with strong hydrogen chloride, and a crystal of potassium chlorate be thrown in from time to time, chlorine and its oxides are evolved, and a solution of cupric chloride is formed—

$$KClO_3 + 6HCl + 3Cu = KCl + 3H_2O + 3CuCl_2.$$
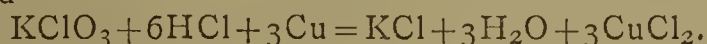
But, if the temperature of the liquid which is still standing over excess of copper be lowered to 70° to 80°, the addition of the chlorate being continued from time to time, a deep brown solution of cuprous chloride is gradually formed.

An identical method has been used by Regnault (*Comptes Rendus*, lix., 319) for covering photographic plates with a film of cuprous chloride.

Other oxidising agents, such as potassium dichromate or bleaching-powder, may be used; but I have found the chlorate to answer far the best, if the solution be kept between the temperatures 70° to 80°.

When common yellow hydrogen chloride and copper turnings are used, the reaction takes place with far greater facility than in the case of the pure substances; the formation of cupric chloride, either at the beginning or end of the process, being inappreciable.

This reaction furnishes an easy and inexpensive means of procuring pure cuprous chloride in the crystalline condition. A flask, containing copper turnings and common hydrogen chloride, is heated to between 70° to 80°, a crystal of potassium chlorate being thrown in from time to time. When the copper is very nearly dissolved, the deep brown solution is poured into water. Cuprous chloride falls as a dazzling white crystalline powder, which is washed once or twice by decantation, to remove potassium chloride and any free acid. The precipitate may then be dried with the usual precautions, or dissolved for use in ammonia or hydrogen chloride.

It is, perhaps, worth while to remark that the cuprous chloride prepared in presence of free acid does not decompose, when kept under water, into the oxide, as that prepared from cupric chloride does, but very slowly forms traces of cupric chloride in solution.

Nov. 12, 1874.

NOTES UPON ANIMAL CHARCOAL.
IRON IN CHAR.

By ROBERT FRAZER SMITH, F.C.S.
(Continued from page 203.)

THE method generally followed in Scotch laboratories for the estimation of iron in char is as follows:—

Five grms. are incinerated in a capsule, and the residue washed out into a small flask with strong HCl without filtration. The liquid is boiled, and a standard solution of stannous chloride dropped in till the yellow colour disappears. With all due deference to the highly-experienced chemists who use it, it strikes one that great advantage would accrue to students if they were taught as well the classical permanganate process. Still withal, practised operators get very concordant results.

Expt. 13.—A sample of char was divided into two halves—one treated by tin, and the other by permanganate. Both were calcined before dissolving in acid. Another sample of same char was tested for iron by permanganate without previous ignition; the filtrate from the carbon being titrated.

	Tin.	Permanganate.	
		Previous ignition.	Without ignition.
Fe_2O_3	0·79	0·89	0·89

The solution for permanganate was first treated with SO_2. The HCl solution seems to have had no organic matter dissolved out. The solutions for permanganate were diluted to 250 c.c., and at a temperature not exceeding 13°.

The following analyses of three working stocks and a new home and foreign char may be interesting in view of what I have already said. They were recently analysed in my laboratory.

	1.	2.	3.	4.	5.
Carbon	6·63	15·39	11·56	11·28	11·10
Loss at low red heat in closed crucible	1·88	0·12	4·11	0·31	3·15
Calcic and magnesic phosphates (by difference)..	81·04	80·69	75·84	82·18	76·11
Calcic carbonate ..	7·96	0·81	7·55	1·57	6·62
Calcic sulphate ..	1·52	traces	traces	0·17	traces
Ferrous sulphide ..	0·03	traces	traces	0·74	0·23
Ferric oxide	0·19	0·73	0·23	0·41	0·07
Sand	0·75	2·26	0·71	3·34	2·72
	100·00	100·00	100·00	100·00	100·00

No. 1 is from a refinery in which only beet sugar is used, and special means are taken to " degypsumise " the char by alkaline solutions. This stock is twelve months old. (German.)

No. 2 is a stock from an English house, working cane sugar all the year round. Six months old, and carefully handled.

No. 3 is the same char as No. 2, fresh from the maker.

No. 4 is from a foreign refinery working mixed cane and beet. Twelve months old, and badly used.

No. 5 is the same char as No. 4, as received from the dealer.

The sugar from No. 1 is poor in colour, but healthy looking; that from No. 2 is rich in bloom, and in every way satisfactory. The sugar from No. 4 is grey and unhealthy looking.

Expt. 14.—Char which remains exposed to the air for a long time gradually decreases in sulphides. For example, a portion lay upon a cooling-floor two months—

At first contained = 0·080 $CaSO_4$.
= 0·305 FeS.

After one month = 0·120 $CaSO_4$.
= 0·266 FeS.

After two months = 0·180 $CaSO_4$.
= 0·225 FeS.

The iron in char at every revivification is reduced to the metallic state. It is sometimes supposed to be as ferrous oxide, but there can be no doubt that, in presence of so much carbon monoxide and other reducing gases, it passes through the slides in the metallic state. One ton of char from the cisterns (calculated to dryness) will yield at least 600 cubic feet of CO, more than sufficient to reduce all the iron of the most ferruginous char.

Expt. 15.—Twenty grms. of kiln-head char, previously dried at 100°, heated in a tube to the usual temperature of revivification, and the evolved gas collected over water. No attempt was made to analyse the gases, from lack of apparatus at the time; but it was freed from CO_2, and, from the appearance of its flame, it was believed to be CO principally, mixed, no doubt, with marsh-gas, &c. It was inflammable gas, the same as is so frequently seen burning about the kiln-pipes. After making all deductions, 344 c.c. were evolved.

If the temperature of the kiln were too high in presence of calcic carbonate, no Fe would form, but simply FeO; but in no case is the temperature sufficiently elevated to decompose chalk.

ESTIMATION OF CARBON IN CHAR.

The estimation of this substance in char is an event of daily occurrence in most sugar refinery laboratories. There is a considerable amount of discrepancy continually being found between the results of different operators on the same sample. For instance :—

Expt. 16.—A sample was halved, and given to two chemists for a carbon determination. A boiled 5 grms. with 40 c.c. of concentrated HCl for half an hour, diluted, filtered, and finished in the same way as B, who boiled his 5 grms. for twenty minutes with 30 c.c. of HCl and 30 c.c. of water.

	A.	B.
Carbon = {	10·55	10·66
	10·52	10·63

It seems that the proportions used by B are the most reasonable; and only by using uniform quantities of acid and char can the results at one time compare with those at another.

Time is of great importance in laboratories where earnest work is being done, and any proposal to shorten a process should be received with pleasure if the results are equally accurate. On many occasions, twelve to eighteen estimations of carbon are done in a few days. I find, by experience, that washing the carbon with alcohol saves at least two hours on each individual estimation. The time taken by a youth who is fairly dexterous at such work was as follows, comparing the two ways :—

By Alcohol Washing.	By Usual Washing.
Weighing, 5 minutes.	
Boiling, 20 ,,	
Filtering, 30 ,,	Drying, 210 minutes.
Drying, 100 ,,	
Burning, 20 ,,	

175 minutes.

Say, three hours; or nearly two hours saved.

The whole process is as follows:—Five grms. are boiled in 30 c.c. of HCl and 30 c.c. of water for twenty minutes. The filter, which has been first moistened with alcohol and dried at 100° till it ceases to lose weight, is then used for collecting the carbon, which is carefully washed with boiling-water till the total washings amount to 200 c.c. After draining, it is finally washed with 40 c.c. of alcohol of 90 per cent, again drained and placed in the bath, dried till the weight is constant. The weights of the same carbon by the two methods will show the completeness of the drying.

In Water-Bath at 9·15.

	Alcohol.	Usual.
Filter + bulb =	7·7260	7·6990
1st weighing	8·6900—10·15	9·1100—11·15
2nd ,,	8·5040—10·30	8·8200—11·55
3rd ,,	8·4205—10·55	8·4765—12·15
4th ,,	8·4135—11·10	8·3910—12·45
5th ,,	8·4135—12·00	8·3905— 1·00
Carbon + silica =	13·75 per cent.	13·83 per cent.

It is not advisable, as recently advocated in the CHEMICAL NEWS, to dry at any greater temperature than 100°. No constant results are got by using the air-bath.

(To be continued.)

LABORATORY NOTES.
PREPARATION OF PURE CARBONATE OF SODA, PURE CARBONATE OF POTASH, AND ABSOLUTE ALCOHOL.*

By J. LAWRENCE SMITH,
Louisville, Kentucky.

FROM long experience I have found it vain to rely upon manufacturers of chemicals for reagents of that exceeding purity which all analytical chemists often require for conducting their researches, and it has been my habit, through a long experience in analytical chemistry, to prepare with my own hands certain of the chemicals used by me, and, while many of the processes of preparing them embrace nothing specially novel, still my experience in making them has been of certain importance to others, and from time to time I will take opportunities to give more general information of these methods, which may possibly be of service to some, especially as, while seeking first for purity, I have been obliged to economise time by the least amount of manipulation.

Pure Carbonate of Soda.

For many years all the carbonate of soda used by me in mineral analysis has been prepared in the following method, viz., by making oxalate of soda and then decomposing it by heat. It can be described in the shortest possible manner by giving the figures and method employed for obtaining a given result. The carbonate of soda commonly used has been the crystals of ordinary sal soda, washed with a little water to detach the adhering dust, or if one has pure soda at his command it can be used to advantage. The oxalic acid used is the ordinary oxalic acid of the shops once re-crystallised, of which re-crystallised acid I always have a supply of several pounds in my laboratory.

63 grammes of oxalic acid and 143 grammes of sal soda are dissolved by heat in 200 c.c.m. of distilled water—filter the solutions if necessary—to the solution of soda, when cold, add the solution of oxalic acid, just hot enough to keep from crystallising; add it by degrees, stirring well; after the mixture is completed, it is expected that the solution will have an alkaline reaction, to keep any trace of soda in solution; the oxalate of soda will be precipitated in great part shortly after the operation is completed; let stand for a short while to cool completely, decant the supernatant liquid, add a little distilled water, break up with a stirrer the lumps of crystals that may have formed, throw on a filter over a Bunsen aspirator, using a six-inch filter, wash with about a half litre of distilled water, and let dry. This may be placed aside in a glass bottle if not needed at once for forming carbonate of soda; the quantity of dry oxalate produced is 30 grammes. To convert into carbonate project the oxalate little by little into a platinum capsule over a good-sized Bunsen burner; after being strongly heated, the oxalate is decomposed into the carbonate, and, if heated high enough to be fused, will furnish about 23 grammes of fused carbonate of soda; fused or not dissolve in water, filter, evaporate to dryness, dehydrate over a naked flame, and granulate it by stirring when hot.

Double or quadruple the quantities above given may be operated upon at once with similar results. The carbonate of soda thus made is perfectly free from chlorine, sulphuric acid, silica, or other impurity that will interfere with its use in analysis.

Pure Carbonate of Potash.

It may be wrong to use the word pure in connection with the preparation of this substance in the manner to be described, as it may contain at the end of the operation a trace of nitrate of potash. The starting point is pure nitre, which is a cheap potash salt, and can be readily purified by repeated crystallisation; the other is oxalic acid, the commercial acid re-crystallised once or twice; 50 grammes of pure nitre and 100 grammes of oxalic acid are placed in a platinum capsule; to this is added a small quantity of water, and heated over a gas-burner; before the mixture is entirely dry, a second portion of water is added and the heat continued until the mass is brought to dryness, at which time nearly all the nitric acid of the nitre is expelled; the heat is now continued and the whole mass brought to redness, breaking up the lumps with an iron rod, when the oxalate of potash formed will be decomposed into the carbonate; the mass is treated with water, filtered, dried, and granulated over the flame; this furnishes about 31 grammes of carbonate of potash, which, as I have already said, may contain a little nitre, but this in no way interferes with the ordinary use of carbonate of potash in making fusions. For this purpose I commonly mix equal parts of carbonates of soda and potash at the time they are required for use.

Absolute Alcohol.

This substance, as obtained in commerce, very seldom marks more than 98 to 99 per cent. It is, however, not unfrequently made in our laboratories, and when this is done the usual method is employed of pouring strong alcohol on lime until the lumps of lime are covered. This method of proceeding gives a thick magma which, when heated over a water-bath, allows the alcohol to pass over but slowly, and much of the alcohol is lost from the impossibility of the heat penetrating the thick mass. The method I follow differs from this in no way except in the quantity of lime employed; using the smallest quantity of lime necessary to abstract all the water, it is surprising how complete the lime will perform its function in this respect. Take, for instance, one litre of alcohol of 94 per cent; this contains about 60 grammes of water; if to this be added 120 grammes of good and fresh-burnt lime, requiring about 40 grammes of water to convert it into hydrate, actual experiment proves that when kept in contact with the alcohol a sufficient length of time it accomplishes this absorption of water, and the alcohol decanted from the precipitated lime will be fully 98 per cent.

Operating upon this fact, I have been long in the habit of supplying myself with alcohol of 98 and 100 per cent, by proceeding in the following manner:—I have in my laboratory three or four 2-litre bottles, into each of which I place 1½ litres of 94 per cent alcohol, the strongest alcohol sold in commerce; to this is added 180 grms. of fresh-burnt lime, of the best quality, broken up into a coarse powder. These bottles are set aside on the shelf, and agitated from time to time: the oftener this is done the more rapid will the reaction be accomplished. A week or ten days will usually suffice, when the bottles are allowed to remain at rest, and the hydrate of lime will settle in a few days, and by a syphon two-thirds of the original alcohol can be drawn off free from lime, which marks 98 per cent alcohol, and when filtered and 50 c.c.m. evaporated to dryness there will be left only the merest trace of lime, less than ½ milligramme. But, of course, re-distillation is so simple that if we wish the alcohol at 98° it can be readily distilled over a water-bath. The magma remaining in the bottle, when distilled over a water-bath, furnishes the remainder of the alcohol about one-half per cent higher.

When absolute alcohol is desired, take the alcohol just as it has been syphoned off or distilled from the magma, put it in a convenient flask for distillation, and to each litre add 120 grms. of lime in coarse powder; attach to a Liebig condenser inverted, so that the alcohol will run back into the flask when condensed: this is continued for an hour and a half or two hours. The condenser is then placed in its normal condition, and alcohol distilled over which will mark 100 per cent. Recently I have learned that there is a method adopted of making the absolute alcohol by one distillation, operating by the inverted condenser first, but in this process the amount of lime called for is the usual quantity, whereas I find that by reducing the lime to its minimum, and always having bottles ready to furnish 98 per cent alcohol, the operation is facilitated, and the loss diminished. So that with the ordinary conveniences and appliances of the laboratory, that are always at hand to be mounted, I can, with fifteen or twenty minutes of *personal attention and manipulation*, obtain a litre or two of absolute alcohol. Of course the time for the reaction of the materials and the distillation is not referred to, as this requires little or no supervision.

ON ANTHRACEN AND ALIZARINE.*

By FREDERICK VERSMANN, Ph.D.

(Concluded from page 224).

IN arriving at the second part of my paper, the conversion of anthracen into alizarine, I am almost afraid of touching it, because the few remaining minutes will only suffice to treat the subject in the most superficial manner, and because I must say a few words on madder and its preparations, the very life and existence of which are seriously threatened by this new industry.

In the East the madder-plant has been known since the earliest times; from there it came to Greece and Italy, thence to the south of France, Alsace, Holland, and Germany. In Holland it has been cultivated more than 300 years; in France it has risen to great importance since the middle of last century, especially in Avignon, which now produces about one-half of all the madder consumed, to the value of about £750,000 per annum. Turkey and South Russia also supply considerable quantities of high quality. Some experiments in cultivating madder in this country have been made in Derbyshire some years ago, but with indifferent results. The soil, the climate, and the weather have the most decided influence upon the growth of the plant, and the subsequent development of the colouring principle. The Dutch madder will dye red, but not purple, and the colour is not fast. Naples madder dyes good red and purple, but the colours are not fast; that of Turkey dyes good red and purple, and is very fast. France supplies the market with two qualities, called "rosées," from their dyeing beautiful reds and pinks, and "paluds," which gives a good purple, besides fine reds, and is the best French quality. The last name is derived from the fact that the plants are grown on marshy land.

The cultivation of the plant and the ultimate separation of the colouring principles is a matter of much time and uncertainty. The root must remain in the ground for a long time—in France two or three years, in Turkey five and seven years—and after having been dried and coarsely powdered, it must be kept another year or two to develop the colouring principles which are not ready formed in the root.

For many centuries, and until the beginning of the present one, the root was used direct, and no attempt was made to separate the colouring matters or to apply them in a concentrated and pure form, but with the development of technical industry and scientific investigation the concentration or separation of the valuable constituents gradually commenced. The first step was the manufacture of "fleur de garance" madder deprived of all substances, soluble in water, and then dried again, which reduced the bulk to about 60 per cent. The washings contain a considerable amount of sugar, which by some French manufacturers is converted into alcohol.

---

* Read before the Society of Arts, Chemical Section.

A ton of madder gives about 15 gallons of alcohol of rather unpleasant flavour, but well adapted for technical purposes.

Garancine is madder further treated with sulphuric acid, which destroys part of the ligneous fibre, yielding about 25 per cent, in the form of a fine powder of light brown colour.

Alizarine verte and purpurine are the results of treating madder with sulphurous acid, which dissolves both : after adding sulphuric acid to the solution and heating to 40° C., purpurine separates about half or three-quarters per cent, and on further heating to 100° C., alizarine verte separates about 3 per cent.

Yellow alizarine is obtained by further purifying this alizarine verte.

Extracts of madder are mostly obtained by treating the root with boiling water, collecting the precipitates which separate on cooling, mixing them with gum or starch, and adding acetate of alumina or iron. This is, in fact, a mixture of colouring matter and a mordant, which may be used for printing direct. These are the principal madder preparations, many of which are manufactured in this country.

In speaking now of artificial alizarine and its manufacture from anthracen, the three principal links in this process are seemingly :—

Anthracen	$C_{14}H_{10}$
Anthrachinon	$C_{14}H_8O_2$
Alizarine	$C_{14}H_8O_4$

The conversion of anthracen into anthrachinon does not offer any difficulty. It has been studied by Anderson long before any practical application ever was thought of.

Chromic acid or nitric acid readily effects the change, but chromic acid is preferable, inasmuch as nitric acid also gives rise to the formation of some nitro compounds. The crude product is readily purified by sublimation, when the anthrachinon is obtained in fine yellow needles, which melt at 275° C.

Anthrachinon strongly resists the action of any oxidising agent, and although Wartha succeeded in converting small quantities into alizarine by heating it with an alcoholic potash solution, still this direct oxidation is practically not possible ; it therefore became necessary to further convert anthrachinon into a compound, which, when treated with potash, would yield alizarine.

The methods of converting anthracen, not only into anthrachinon, but into a further substitution compound, form the principal subject of different patents, a short review of which will at once give the history of the rapid development of this new industry.

Graebe and Liebermann, the original discoverers, claim in their first patent the treatment of anthrachinon with bromine or chlorine, thereby obtaining bibrom or bichlor anthrachinon, which, fused with caustic potash, yields alizarate of potash, and this in its turn decomposed by hydrochloric or any other acid leaves alizarine. They also obtain the bromine or chlorine compound without the formation of anthrachinon by acting upon anthracen direct with bromine or chlorine, thus obtaining the tetra-brom anthracen or corresponding chlorine compound ; this boiled with nitric acid gives bibrom anthrachinon.

$C_{14}H_{10}$	$C_{14}H_{10}$
$C_{14}H_8O_2$	$C_{14}H_6Br_4$
$C_{14}H_6Br_2O_2$	$C_{14}H_6Br_2O_2$
$C_{14}H_6K_2O_4$	
$C_{14}H_8O_4$	

Broenner and Guzhow's patent, the next one, is so confused that it is difficult to clearly understand it ; but it seems evident among a great mass of irrelevant matter they point out that the above treatment with bromine and chlorine may be substituted by the action of sulphuric or nitric acid. They claim to produce not only alizarine, but also purpurine.

Caro, Graebe, and Liebermann, in another patent, claim the production of the sulpho acid of anthrachinon by treating anthrachinon with sulphuric acid, removing excess of sulphuric acid by carbonate of lime, then adding carbonate of soda, evaporating the solution of the soda salt to dryness, and fusing it with caustic soda or potash.

They also avoid the introduction of anthrachinon by treating anthracen direct with sulphuric acid, and obtain the bisulpho acid of anthracen, which is converted into bisulpho acid of anthrachinon by means of oxidising agents, such as peroxide of manganese.

$C_{14}H_{10}$	$C_{14}H_{10}$
$C_{14}H_8O_2$	$C_{14}H_8(HSO_3)_2$
$C_{14}H_6(HSO_3)_2O_2$	$C_{14}H_6(HSO_3)_2O_2$

The first part of the last patent, viz., the formation of the bisulpho acid of anthrachinon, is also claimed by Perkin in a patent dated one day after Caro, Graebe, and Liebermann's.

Perkin holds also the next patent in which anthrachinon is again avoided. Bromine or chlorine compounds of anthracen are acted upon by sulphuric acid, and the result oxidised by peroxide of manganese. Dale and Schorlemmer have further simplified the reaction ; they boil anthracen with sulphuric acid, remove excess of acid by carbonate of lime, and treat the solution with caustic potash and nitrate or chlorate of potash. The last patent has been obtained by Meister Lucius and Bruening ; this embodies the treatment of anthrachinon with fuming nitric acid and production of mononitro anthrachinon.

I can do nothing but give the reactions which are intended to be produced, without attempting to allude to the great delicacy of the operations. I need scarcely say that at every step the most attentive care is required, because almost every reaction may either be not carried far enough, or may be carried too far, and in either case total or partial failure in the manufacture must be the inevitable consequence.

I have merely given the seven patents because they will best show the tendency to simplify the original elaborate and costly processes, and that this has been effectually done is shown by the large quantity of alizarine produced, and by the great reduction in price.

The artificial product is mostly sold as paste, which is better applicable than a dry powder, which would not mix so well and uniformly. Of course this paste is not chemically pure ; but whereas two years ago many samples did not contain more than 5 per cent of alizarine, the quality has now vastly improved.

Pure alizarine may readily be obtained by evaporating the paste, and then extracting the colouring matter, or by sublimation, as shown by different specimens.

Great doubts were first expressed as to the quality of the dye compared with that of madder preparations, but they seem not to exist any longer : it has been convincingly proved by Bolley, Kopp, Schunck, Perkin, and others, that the natural and artificial alizarine are identically the same, and the same results are produced.

The question of price has also been settled ; whereas not two years ago the difference was greatly in favour of madder, it is now about the same, in consequence of the greatly increased production.

There is now one factory in this country, founded by Perkin, one in France, and more than a dozen in Germany and Switzerland. Some idea of the extent of this manufacture may be formed from the fact that last year more than 1,000 tons of 10 per cent paste were produced, in value of £500,000, and it is stated that one German firm are preparing to make 500 tons a year.

The effect upon madder cultivation has naturally been most serious, and especially at Avignon the question is most anxiously discussed whether the artificial alizarine will ultimately drive the madder out of the market altogether. The vitality of the new product is more then secured, but

although it must very seriously injure the madder interest, it need not necessarily kill the natural product altogether. There may be room for both, and an increased production may, and undoubtedly will, insure a vastly increased consumption.

Such effect we have seen with the introduction of the aniline dyes; a whole series of new compounds of formerly unknown shades have sprung up of a total value of about £2,000,000 a year, and have they thrown any of the old dyes, madder, or indigo out of the market? No; new applications have been found, more coloured articles of every description are used; and so it will be the same with alizarine—the more it is manufactured, the more it will be used.

No doubt the madder growers will have to struggle hard in the competition, and of this they seem to be aware already. Only the other day the Agricultural Society of Avignon inquired of the Industrial Society at Mulhausen what they had to fear of artificial alizarine. The answer was that to successfully compete, they must improve their product; they must not only sell the raw material, containing but a few per cent of valuable matter, but they must call in the assistance of science; they must manufacture the extracts of such quality as is made in Paris and England; but that it was impossible to drive the artificial product out of the market again. In such manner the artificial alizarine will have the merit of improving the quality of its ancient rival.

But even supposing madder cultivation were destined to die out, would the ultimate general advantage not more than compensate the individual loss? Many thousands of acres of land would be set free, and would with other crops give a better return than now, when the root must remain for years in the ground. Seldom, if ever, have such splendid results been obtained in so short a time. Here we see a most unpleasant and perfectly useless greasy substance suddenly turned into one of the most beautiful colouring matters; a new application for immense quantities of various chemicals is found, a number of important manufactures is started, the effect of which is felt more deeply than we can be aware of. And science itself, in accomplishing this revolution, largely profits by it, because the investigation of all the connecting links has of late years given us an insight into the internal arrangement and constitution of these chemical compounds, hitherto unknown.

To England especially the practical part of the question is of the greatest importance, because, after all, England is the great tar-producing country, and the principal supply of anthracen must always come from here. The nine London gas works alone convert about 1½ millions tons of coals into gas, and produce about 12 million gallons or 60,000 tons of tar a year. The gas companies have not been slow in profiting by this invention; the price of tar has already been more than doubled, an increase almost sufficient to reduce the price of gas a penny or twopence per 1,000 feet.

And finally, must alizarine be the only colour derived from the solid hydrocarbons? It is not very likely that others will be produced from anthracen and its homologues.

Boettger has already separated an anthracen orange of great dyeing power; Springmuhl has succeeded in obtaining a most beautiful blue, the only drawback in the manufacture of which is at present that it would cost about £600 a pound; but one might almost say this is the least difficulty, because the compound once obtained —an easy and economical process of manufacture—is almost sure to follow. But while we are thus waiting for further triumphs in this and similar directions, let us not forget to honour and to admire the perseverance, energy, and industry of those scientific minds who, whatever their nationality, have contributed in solving the great problem of imitating and outrivalling nature's silent working, and who have succeeded in producing on scientific principles one of the most lovely natural colouring matters.

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

Saturday, November 7th, 1874.

Professor W. G. ADAMS in the Chair.

AT this meeting, the first of the session, the certificates of eight candidates for election were read.

A communication was read from Mr. G. F. RODWELL, "*On a New Instrument for Multiplying Small Motions.*" It consists of a train of multiplying wheels, the first of which is moved by the body whose elongation is to be determined, while the teeth of the last engage with the threads of an endless screw, whose axis is vertical, and carries at its upper extremity a long index moving over a graduated circle.

Professor G. C. FOSTER made a communication "*On the Geometrical Treatment of certain Elementary Electrical Problems.*"

Professor GUTHRIE read a paper "*On Salt Solutions and Water of Crystallisation.*" The absorption of heat which occurs when a salt is dissolved in a liquid was shown to depend, not only on the relative specific heats of the salt and the liquid, but also upon the molecular ratio of the resulting solution. This ratio declared itself—(1) Optically, by the singularity of the refractive index when the critical ratio was attained; (2) by the singularity of the density at the same point; (3) by the heat absorbed when (α) a saturated solution was mixed with the medium, and (β) when the salt itself was dissolved in a certain quantity of the medium. The condition of maximum density of water was referred to the existence of a definite hydrate of water. It was shown that every salt soluble in water is capable of uniting with water in definite ratio (by weight), forming definite solid compounds of distinct crystalline form, and constant melting and solidifying points. It was supposed that the ratios of such union are not incommensurable with the ratios of chemical weight, and that the new class of bodies which only exist below 0° C., and may be called " cryohydrates," are not discontinuous with the hydrated crystalline salts previously known. A few cryohydrates were described as being obtained from the saturated water solutions of the respective salts on the withdrawal of heat. Thus chloride of sodium combines with 10·5 (? 10) molecules of water, and solidifies therewith at −23° C. Chloride of ammonium combines with 12 molecules of water, and solidifies at −15° C. The combinations with water were given of the sulphates of zinc, copper, sodium, and magnesium; also those of the nitrate of potassium, the chlorate of potassium, and the bichromate of potassium. So far as the experimental results at present indicate, it appears that those cryohydrates which have the lowest solidifying-point have the least water. Some suggestions were offered concerning the application of these experimental results to the explanation of the separation of the Plutonic rocks from one another, and the importance was pointed out of the use which these cryohydrates will have in establishing constant temperatures below 0° C., as fixed and as readily attainable as 0° C. itself.

Lectures on Crystallography at the Chemical Society.—We are glad to be able to state that a considerable number of Fellows of the Chemical Society and others have intimated their intention of attending Professor Maskelyne's lectures on crystallography at the Chemical Society, Burlington House. The lectures will therefore commence on Monday evening next, at half-past eight o'clock.

CORRESPONDENCE.

DOUBTFUL MINERALS.

To the Editor of the Chemical News.

SIR,—The science of mineralogy appears in a mess, and mineralogists not only in a muddle, but afraid to put their heads together in order to get out of it.

Being the nature of T. A. R. to stick to a subject, I propose, therefore, with your permission, to retain my antiseptic initials, because, I tremble at the very thought of their eminences the cardinals of chemistry and their sovereignty to atomise. It is a little comfort, however, to know that theirs is a limited monarchy, and that they profess only to deal with atoms. But a very small David can fling stones. I flung 150 at once the other day in the hope of hitting, without hurting, somebody whom they might concern. A few of them appear to have fallen harmlessly near Owens College, and Dr. Burghardt has picked them up. Thanks, many and sincere, to him for coming to my aid in an attempt to slay the Goliath of our Mineralogical Babel. Allow me a word in reply to Dr. Burghardt's communication. I have not lately, as he fears, been ransacking ancient mineralogical works. I had once a very long spell at that amusement. A good many years ago I acquired an agreeable habit of collecting stones, with no other object than to observe their differences. I had then only stone-books to look at and read. I was quite happy until I conceived the wild idea of possessing a specimen of every known mineral and a copy of every mineralogical book. The serious question of finance, however, stood in the way for some time. But nearly a quarter of a century ago, I started fairly, as I thought, with a five-and-twenty-guinea collection of minerals, which, together with my own random accumulation, made a tolerably good show. Fortified with the standard books on mineralogy, I thought I might hit what I aimed at. My dismay was not trifling when I found my standard labels covered with synonyms, and my standard authors as much of a hindrance as a help. I therefore gave up the pursuit for a few years. My old love of collecting, however, returning, and being financially improved, I went in rather rashly for more minerals and more mineralogical books. I got more addicted to Stevens's sale-rooms than to a Kursaal, and bought many a hundred-weight of both minerals and books. Dr. Krantz also was favourable to my hobby, and Spon very good naturedly got what books I was short of. My troubles now began. My first idea was to accomplish the apparently easy task of making simply a *list* of mineral species and their varieties! I arranged my books in chronological order out of respect to the "Fathers of the Science," and began at the beginning to open a ledger account with each mineral, and to copy into a waste-book all the synonyms. (No small bulk at the present time). I think I have analysed since then every mineralogical treatise in the English language, from Jeffries of 1751 to the present time, resolutely posting my ledger all the while. All I shall say of this labour is, that it has been very like the work of a squirrel in a cage. Hence my list of 150 questionable acquaintances. They are unproductive and a nuisance in my ledger, and I should like them written off my books at once as *bad*. I want, however, those in authority to prove them bad. My ledger has been carefully checked by all the editions of Dana's system of mineralogy. In 1868-9 I went throughout the fifth edition *twice*. The interesting weariness of the occupation reminded me constantly of "doing" twice the Vatican in damp weather. Dana's book is ancient now, as Dr. Burghardt says; but no really big gun has gone off since. An advertisement appeared not long ago that the cumbrous thing had been "re-written and enlarged," and published at 35s. The announcement interested me.

Leisure permitting, I proposed to myself another dead set of a couple of hundred hours at auditing my ledger. I bought the book, but to my annoyance got only 19 pages of *appendix* for my money, the other 827 pages remaining exactly as my old thumbed copy of 1868! This ruffled my feathers a little, and in dudgeon I sent off at once my old list of offenders to the CHEMICAL NEWS, which is, I think, the most appropriate vehicle for perplexing matters of this kind.

Referring to Dr. Burghardt's communication, I am induced to remark that the Beaumontite of Levy is undoubtedly Heulandite, but the Beaumontite of Jackson is said to be "a variety of siliceous malachite, or an allied mineral, containing silica, water, and oxide of copper." (*Watts's Chem. Dict.*, i., 525). Who knows more than this about it? Belonite of Glocker is said to be Aikenite; but Belonite of Zirkel is not; moreover, Zirkel's Belonite and his Trichite appear to be identical; that is to say "microscopic acicular crystals found in glassy volcanic rocks, and may be felspar." Can more light be thrown on this? The "three layers of mineral found in a nodule of amygdaloid" were called by How as follows:—The outer layer Cerinite, the middle layer Centralassite, and the inner bluish mass Cyanolite. Dana says Centralassite is *probably* Okenite; but what exactly about it and the other two so-called minerals?

The Dopplérite of Haidinger and that of Deicke may be both hydrocarbons; but who tells the difference? The Herrerite of Del Rio is an impure Smithsonite according to Dana; or, Hemimorphite according to Maskelyne; but the Herrerite of Herrera is said to be "telluride of nickel with carbonic acid." Who knows and will say whether it is so? Is it meant that Kalkoolborthite is synonymous with Volborthite? I have a specimen of the latter, and have put down the former as a variety, having somewhere heard or read it so. I can't tell where; but no matter, originality in the science is often difficult to determine. Dr. Burghardt writes "Dumasite is Chlorite." I find that I once wrote the same. Dana admits chlorite in his little manual of 1867, and delicately stifles it in his big book of 1868; no account being published of the inquest. Maskelyne refers Chlorite to Clinochlore, Pennine, and Ripidolite: all three. What *is* Chlorite? Some eminent geologists still talk about Chloritic rocks. The Doctor says "Polyhalite is rightly named." Polyhalite of Stromeyer, yes; but I want an authority to say whether the Polyhalite de Vic of Berthier is one and the same thing; probably so; but who will establish the fact? If Zamtite be the Zaratite of Dana, then simply out of compliment to Professor Maskelyne, Zaratite should be called Texasite. Alas, poor students with short memories!

By way of gentle mental exercise allow me to introduce a party of the family Antimony with a stranger and an outcast or two just dropped in. Here they are:—Stibite, Stiblite, Stibilite, Stibium, Stibiolite, Stibnite, Stibine, Stibiconite, Stibiconise, Stilbite, and Stillolite. A lisp is not at all ugly now and then amongst the fair sex; but the sibilance in this family, I should think must be, at times, a great bother to professors as well as to students. The list for explanation might be used with varied results in the civil service examination papers. Examiners might perhaps, get over their work pretty quickly.

Some of the present names of minerals are simply silly. Some have been named as being unlike something else; others, because they turned out differently to what was expected of them. Some are worse than bad puns. The agony in bringing forth these abortions must have been frightful. I will give one illustration:—Gahn, a Swedish chemist, finds a puzzling mineral and hands it to Ekeberg, who is astonished to find zinc in such an unexpected place; he reaches down a lexicon and finds that αὐτομόλος means a *deserter*, and he forthwith brands the culprit (who has never run away) with *automolite*. But Von Moll, the next year, thinking this an insult to nature more than to common sense, commanded that it should no more be called Automolite, but *Gahnite*, after the discoverer. Ekeberg, Abich, Genth, and others, called it Automolite,

or Automolite, as it might happen, and so do some people now. I think *zinc-spinel* more intelligible; but then it is not classical. Mineral dealers sell us Automolite, Dysluite, and Kreittonite as varieties of spinel. Dana sticks to making them varieties of Gahnite. Maskelyne extinguishes automolite, and makes Gahnite a variety of spinel, which appears the right thing to do.

Please to look at a few modern atrocities. Dana wants people to call Copper pyrites, Chalcopyrite; Steatite, Saponite; Hornblende, Amphibole; Amber, Succinite; Blende, Sphalerite; and common salt, Halite; &c., &c.

Professor Maskelyne wishes Turquois to be called Calaite; but ladies, one and all object; so do the jewellers. What are these resurrectionists about? What is the use of digging up these old coffin-plates?

The premier mineralogists can hardly pretend to infallibility just yet, their allocutions notwithstanding. Is a spade not to be called a spade in future? Are infants to wear succinite necklaces? Are all of us to eschew common salt at dinner, and to "*pass the Halite*" instead? It will be done, I expect, when a cricket-ball shall be called in common a sphere, and a cork-screw Archimedes.

I for one incline to take my stand patriotically by the British Museum; but when Doctors, who are full head and shoulders above me, differ so widely as to what certain minerals should be called, what can a short fellow like me decide?

I append a list of some of the Doctors' differences; be so good as to print it, and by publication help to stamp out this literary scandal, or rather this undignified childish game of 'tis and 'tis'nt.

MASKELYNE v. DANA.

Maskelyne.	Dana.	Maskelyne.	Dana.
Allochroite	Andradite	Keramohalite	Alunogen
Alstonite	Bromlite	Kühnite	Berzeliite
Amber	Succinite	Laumonite	Hypostilbite
Anatase	Octahedrite	Lettsomite	Cyanotrichite
Augite	Pyroxene		
Barytes	Barite	Lievrite	Ilvaite
Bleinierite	Bindheimite	Meerschaum	Sepiolite
Boronatrocalcite	Ulexite	Melanochroite	Phœnicochroite
Blende	Sphalerite	Mispickel	Arsenopyrite
Calaite	Turquois	Nickeline	Niccolite
Chalybite	Siderite	Nickel glance	Gersdorffite
Chlorargyrite	Cerargyrite	Olivine	Chrysolite
Cryolite	Chodneffite	Onofrite	Tiemannite
Copper glance	Chalcocite	Oxalite	Humboldtine
		Pitchblende	Uraninite
Copper pyrites	Chalcopyrite	Pyrites	Pyrite
		Salt	Halite
Cromfordite	Phosgenite	Steatite	Saponite
Dichroite	Iolite	Scapolite	Wernerite
Erubescite	Bornite	Selenite	Gypsum
Fluor	Fluorite	Silicoborocalcite	Howlite
Galena	Galenite		
Glaserite	Aphthitalite	Sphene	Titanite
Gymnite	Deweylite	Texasite	Zaratite
Hemimorphite	Smithsonite	Volcanite	Selensulphur
		Uwarowite	Ouvarovite
Hornblende	Amphibole	Völknerite	Hydrotalcite
Idocrase	Vesuvianite	Websterite	Aluminite
Iodargyrite	Iodyrite	Wolfsbergite	Chalcostibite

T. A. R.

Liverpool, October 22.

PS.—I should very much like to back Professor Maskelyne's penny "Index to the Collection of Minerals in the British Museum" against Dana's 35s. volume. The B. M. acknowledges to possessing 668 species of minerals, and 685 varieties, making a total of 1350. From the books I make nearly a thousand more. Dana (1874) makes about 925 species; but the exact number of varieties is what "no fellow can find out." Why these large numerical differences? Our National Collection ought

certainly to contain a specimen of every known mineral substance; but, according to its own index, it as certainly does not by a very long way. We ought to know the reasons why from the fountain head. Satisfactory reasons no doubt can be given, and if given would save aspirants in the intensely interesting study of mineralogy a vast deal of rough-hewing, puddling, muddling, and impatience. We appear to want a sort of "New Testament Company" for the revision of our Mineralogical Indices. This might easily be constituted if, as Dr. Burghardt says, "mineralogy has made such rapid strides within the last five years, so that a book dating 1868 is already far behind, and almost useless."

The wearers of the seven-league boots are just the men to do the deed. Where are they? Let them be caught.

T. A. R.

FERROUS SULPHIDE IN CHAR.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS, vol. xxx., p. 225, I notice from the pen of Mr. G. Combe Stewart, F.C.S., of Cappielow Sugar Refinery, Cartsdyke, by Greenock, a paper in which *he* modestly claims to have discovered FeS in char, which Mr. R. Frazer Smith—a chemist of some seventeen years' experience—has lately been discussing in your columns.

Mr. Stewart refers incidentally to "the shade of dogmatism which Mr. Smith throws over his communication." Without doubt his own is by far the most egotistical production of the two, or, indeed, which I have ever met in your pages.

Mr. Stewart says that *none* of Mr. Smith's statements are new to *him*; and that while studying chemistry in Glasgow, nearly three years ago, he discovered FeS in char. I humbly submit if it is at all probable that one beginning to study the science of chemistry could so soon discover a matter such as this, the existence of which in char has been suspected and sought for by many of long and varied experience: and allowing that he did hit upon it, why did he not publish it ere this time, and receive the honour due, and not claim it when someone else, who had previously done so, was entitled thereto? It is always the person who first makes a discovery public that has the best and foremost claim to the praise.

But had Mr. Stewart read Mr. Smith's papers and letter more carefully he would have observed that Mr. Smith does not state that *he* had *discovered* FeS in char, but simply that he had *proved* its presence, which was (*only*) *supposed* long ago by Muspratt, but was never verified by experiment.

Mr. Stewart is very fond of using Dr. Wallace's name under which to shield himself; I question, however, if the Doctor will feel flattered to see his name so freely handled by a person of Mr. Stewart's calibre or standing in the chemical world.

He wishes Mr. Smith to consult him, and then he will tell him that he has never overlooked the presence of "these sulphides." Now, Sir, the discussion is about ferrous sulphide, but Mr. Stewart ingeniously omits to say what sort of sulphide he reports in his analyses. I would like to know if he *ever* stated his results as *FeS*, as I have never noticed it put down as such in any analyses but Mr. Smith's; and more, there are chemists in this town, of acknowledged qualifications, who never report the sulphides, either as ferrous or calcium, unless asked to do so.

Mr. Stewart further says that there are a few points in Mr. Smith's annexed analyses which he refrains from touching upon. I defy him to question any of the results therein stated, as I arrived at many of them myself after very careful work, for which in one of his papers Mr. Smith generously gives me the credit.—I am, &c.,

JOHN W. MACDONALD.

Greenock, Nov. 16, 1874.

FERROUS SULPHIDE IN CHAR.

To the Editor of the Chemical News.

SIR,—I notice in last week's CHEMICAL NEWS, page 226, another letter from Mr. Speir, and a copy of a letter he has procured from Dr. Wallace, and annexed report. It appears a rather peculiar proceeding the publishing in a public journal of private documents to satisfy the requirements of a small discussion. As far as I am concerned I regret to take up your valuable space with a personal matter of this sort, but I am not the agressor. The papers I sent to your columns had as their sole object to incite others to publish their experiences, in so far as doing so would not clash with private interests. But I ought to have foreseen that the spirit of the Teutonic epoch still pervades some Greenock refineries. The same dislike to strangers still flourishes strongly among a few who call themselves chemists.

I beg again briefly to state how the matter stands. The origination of the *theory* of the presence of FeS in char was never claimed by me, and cannot be claimed by anyone now living. The *proof* of its presence was afforded by me. If others had previously *proved* that fact, their experiments have never been given to the world. If any such experiments had ever been made they would have been published. Mr. Speir claims to have inferred two years ago that he had found FeS. The laboratory journal shows some estimations of total sulphur, and nothing more, on that point. Eight years' journals kept by that gentleman show nothing but the regulation sugar and char analyses as far as I can see. When I came to the refinery, and not till then, did he become satisfied on the FeS subject. He most courteously intimates that I knew nothing about char till I went to Greenock. If I had depended upon him to lighten my darkness I would have waited long. But I had studied thoroughly the most of what had ever been published upon char, either at home or abroad; and from my employer and others I obtained all the practical information possible. For years I have made chemical technology my favourite study, and been engaged in its practical applications. I worked in the laboratories of Penny, Anderson, Walter Crum, Wöhler, and Fittig; and yet gentlemen who are simply engaged year after year grinding the same monotonous round of sugar and char estimations (work done with perfect and faultless accuracy in some refineries by women), try to make the public believe that they only are competent to analyse char. The fact is, when analyses or consultations of any importance are required the services of men like Dr. Wallace, or Messrs. Patterson and Ogilvie have to be got.

The first two experiments, as well as all the rest, were proposed by me; and Mr. Speir makes a similar mistake to that of his Majesty King George IV., who believed he had commanded a regiment of the guards at Waterloo. He has no more right to claim them than any assistant has who repeats an experiment after his teacher.

With reference to Dr. Wallace's report I do not make, nor ever made, any claim to the discovery of the Speir deposit. I have been simply hitherto a close observer in the refinery, and have taken no part whatever in its management. Mr. Speir is welcome to any credit he may think he has by the deposit.—I am, &c.,

R. FRAZER SMITH.

IMPORTATION OF SULPHUR.

To the Editor of the Chemical News.

SIR,—In the notes "On the Sulphur Industry of Sicily," quoted in CHEMICAL NEWS, vol. xxx., p. 218, from a foreign publication, it is stated that the import of brimstone into England is decreasing. This was some time ago true; but a greatly increased demand has recently sprung up, for which, in view of the new processes for recovering sulphur from residual products, and of the opening up of enormous mines of pyrites like Rio Tinto, I cannot account. From enquiry at the Board of Trade, I find that the quantities imported in the ten months ending October 31, 1872, 1873, and 1874, respectively, were 878,056, 728,379, and 903,840 cwts. A satisfactory explanation of this would be very interesting.—I am, &c.,

ENQUIRER.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 14, October 5, 1874.

Exact Values of the Crystals of Titaniferous Iron (Ilmenite).—M. N. de Kokscharow.—The author states that the results of his recent observations have enabled him to deduce the angles of titaniferous iron with absolute precision, and have at the same time demonstrated its tetrahedrism in an incontestable manner. The details would be unintelligible without the accompanying illustrations.

Report on the Freezing Machine, by means of the Evaporation of Methylic Ether, as Designed by Ch. Tellier; and on the Preservation of Food in Air Cooled by this Apparatus.—Not adapted for abstraction.

Temperature of the Sun.—M. J. Violle.—The author concludes that the true mean temperature of the sun's surface is 2000°.

On Magnetism.—M. J. M. Gaugain.—A detailed account of experiments continued from *Comptes Rendus*, January 13, June 30, September 8 and 29, November 10, and December 22, 1873; and March 22, June 1 and 15, and September 7, 1874.

Conductibility of Woody Bodies and Other Substances of Low Conducting Power.—M. Th. du Moncel. —In this paper the author examines the conductibility of minerals. Although displayed to a great extent under the influence of atmospheric moisture, the electro-conductibility of minerals is subjected to molecular conditions, which cause it to vary within wide limits, according as they are the results of fusion, of crystallisation, or of simple aggregation. It is not here the question of metallic particles which may be present, and which may give them a peculiar conductibility, more or less considerable. In all cases it is a general characteristic of the transmission of electricity through minerals to produce phenomena of polarisation, which are scarcely perceptible in case of woody bodies.

Synthesis of Purpurin, and on Certain Analogous Colouring Matters.—M. A. Rosenstiehl.—MM. Schützenberger and Schiffert, in making a proximate analysis of commercial purpurin, discovered in it a small quantity of a yellow substance which dyed aluminous mordants a poor orange-yellow, and had the composition of alizarin or of its hydrate. M. Schützenberger observed, further, that this substance, *purpuroxanthin*, is produced by reducing purpurin either with hydriodic acid, or with protoxide of tin in an alkaline solution. The study of this body has been the starting-point of the author's researches. (1) We readily obtain purpuroxanthin by causing white phosphorus to act, with the aid of heat, upon an alkaline solution of purpurin. This dissolves without disengagement of gas, and the reduction is completed in a few minutes, the colour of the solution passing from violet-red to red, and then to brown. It is poured into acidulated water; the flocculent precipitate is collected, washed, and dried, the yield being almost the theoretic amount. On filtering the alcoholic solution of this body over animal charcoal, and on adding water, we

obtain purpuroxanthin in the form of a crystalline powder of a very bright yellow. It readily sublimes in needles, the orange-yellow colour of which resembles that of pure alizarin. It dissolves easily in alcohol, acetic acid, and benzol. Water precipitates it from its alcoholic solution in the form of a translucent jelly, which coagulates by degrees into flocks of greater density. Alkalies dissolve it with a fine red colour. Its lime and baryta compounds are slightly soluble in boiling water, which they tinge of an orange-red. Watery solution of alum dissolves it at the boiling-point, but it separates out almost entirely on cooling. It does not dye the aluminous and iron mordants. Its ultimate analysis leaves no doubt as to its composition, which is represented by $C_{14}H_8O_4$. It is, therefore, an isomer of alizarin, and is probably identical with the alizarin of Rochleder. (2) In an alkaline medium it is not permanently modified by reducing agents. Its red colour is, indeed, altered to a brown, but if poured into acidulated water the original substance is reproduced. Hydriodic acid modifies it profoundly. No definite result is obtained on operating in closed vessels, but in making use of acid boiling at 127°, and of white phosphorus at the ordinary pressure of the atmosphere, we obtain at first a substance of a yellow more greenish than the above, soluble in hydriodic acid, alcohol, acetic acid, and benzol, from which it separates out in brilliant lamellar crystals. It is not capable of sublimation. Its alkaline solution is brown, and is oxidised on exposure to the air, reproducing purpuroxanthin. It dyes aluminous mordants almost like quercitron bark. Its elementary analysis admits either of the formula $C_{14}H_{10}O_4$, or $C_{14}H_{12}O_4$. On prolonging the action of hydriodic acid under the conditions indicated, we obtain anthracen and its two hydrides, which have been distinguished by their physical and chemical properties, as well as by ultimate analysis. Phenanthren was not found among the products of this reaction. Purpuroxanthin, if heated with oxide of zinc, gives rise to anthracen. (3) In a boiling alkaline solution an atom of oxygen attaches itself to purpuroxanthin, and the purpurin is regenerated. It is identical with that of madder. The synthesis of purpurin is thus linked to that of an isomer of alizarin, thus giving a second solution to the problem of the industrial production of this precious substance. (4) Repeating the synthetical experiments of M. de Lalande, the author obtained purpurin identical with that of madder, and with that produced by the oxidation of purpuroxanthin. This artificial purpurin, obtained by the oxidation of alizarin, gives rise on reduction, not to alizarin, but to its isomer, purpuroxanthin, which, when submitted to de Lalande's oxidation process, reproduces purpurin. It is therefore established that two isomeric bodies reproduce purpurin by oxidation, whilst, inversely, the reduction of the latter only gives rise to one of these isomers—the one, viz., which does not possess the attributes of a dye. (5) The author has tried the oxidising action of alkaline solutions upon two other isomers of alizarin—chrysophanic acid, and anthraflavon. The former, heated to 195° in a concentrated alkaline lye, is transformed into a substance possessing the tinctorial properties of the proximate principles of madder. It is much more soluble in dilute alcohol than is chrysophanic acid, and it separates out in the form of a deep red crystalline powder. Its alkaline solution has a shade slightly more violet than that of pure alizarin. It dyes alumina mordants of a garnet-red; those of iron of a greenish blue. These shades resist boiling soap-lye very well. From its origin this body should be an isomer of purpurin. Anthraflavon, according to Barth and Senhofer's description (*Ann. der Chem. und Pharm.*, clxx., p. 100), approximates closely to purpuroxanthin. The authors even indicate that, if heated in an alkaline solution, this takes a very rich violet colour, but they did not interrupt the operation at this point, nor did they isolate the products of the reaction. These, in the crude state, dyed mordants like madder, in identical shades possessing the same solidity. With alum-water they gave a red solution,

not possessing, however, the fine fluorescence of purpurin. The proximate analysis of this crude product divides it distinctly into two bodies, one of which, soluble in benzol, dyes mordants like alizarin, from which it differs, however, by its solubility in alum-water. The other dyes alumina mordants like purpurin, but differs from it by its sparing solubility in benzol and alum-water, and by its free solubility in alcohol. Thus anthraflavon, the isomer of alizarin, produces by oxidation simultaneously two colouring matters, which, from their origin, may be isomers of purpurin. The author has compared these various bodies with the isopurpurin discovered by M. Auerbach in the artificial alizarin "for reds," and has proved that it is identical with neither of them. (6) There is a fifth isomer of alizarin, chinizarin, discovered by Grimm. If we admit as isomers the products derived from it by oxidation, and which are all analogous colouring matters of the same solidity as far as chemical reagents are concerned, we are at present acquainted with five bodies of the composition of purpurin. These may be divided into two classes:—To the former belong pseudo-purpurin, purpurin, alizarin, purpuroxanthin, and chinizarin; to the second belong anthraflavon and the colouring matters thence derived, anthrachryson, rufiopin, and rufigallic acid.

New Observations on the Composition of the Waters of Bagnères de Luchon.—M. E. Filhol.—A controversial note referring to the paper page 683 of the present volume of the *Comptes Rendus*.

Volumetric Determination of Copper. — M. Pr. Lagrange.—The author states that the volumetric processes for the determination of copper are few in number, and generally little employed (?). His method is based upon the precipitation of the copper from its nitric or sulphuric solution by hydrate of potash or soda; the conversion of the hydrate of cupric oxide thus obtained into cupro-potassic (or sodic) tartrate; and the reduction of this salt to the red anhydrous suboxide by a standard solution of pure glucose.

Spectro-Electric Tube or Fulgurator for the Observation of the Spectra of Metallic Solutions.—MM. B. Delachanal and A. Mermet.—This paper requires an illustration.

On Supersaturation.—M. Lecoq de Boisbaudran.—A critique on two papers by M. Gernez (*Comptes Rendus*, January 26 and July 27, 1874).

Action of Bromine upon Certain Alcohols.—M. E. Hardy.—The alcohols experimented upon are the propylic, butylic, and amylic.

Production of Oxamic Acid by the Oxidation of Glycocol.—M. R. Engel.—In addition to the carbonate, oxalate, and oxamate of potash, there are other substances among the products of the oxidation of glycol, derived from the oxidation of the oxamic acid itself.

Action of Heat upon Diphenylmethan and Phenyltoluen, and on the Products of the Reduction of Benzophenon.—M. Ph. Barbier.—The author proposes to give the result of his experiments, undertaken with the object of effecting the synthesis of fluoren. From diphenylmethan the chief product obtained was anthracen, with a small quantity of phenanthren, but no fluoren. Phenyltoluen, under the same conditions, yielded benzol and toluen, but no anthracen. In all these pyrogenous carbides elementary analysis is insufficient, since they differ in their percentage composition by quantities not greater than the error of the operation.

Curious Association of Garnet, Idocrase, and Datolite.—J. Lawrence Smith.—The author received specimens of a rock containing these minerals from Santa Clara, California. On examination they were found to consist of calcareous spar, datolite, garnet, and idocrase. The datolite is colourless, crystalline, and perfectly pure, as may be seen from the subjoined analysis :—

Silica	38·02
Boracic acid..	21·62
Lime	33·87
Water	5·61
	———
	99·12

This mineral has not previously been found associated with garnet and idocrase. The garnet is of the variety known as cinnamon-stone (essonite). The crystals are large perfect dodecahedra, green without, and of a cinnamon colour within. Their analysis gave—

Silica	42·01
Alumina	17·76
Ferric oxide	5·06
Oxide of manganese	0·20
Lime	35·01
Magnesia	0·13
	———
	100·17

Specific gravity, 3·59

The idocrase forms fibro-compact crystals of a green colour. It interpenetrates the garnet crystals, so that it is difficult to say where the one ends and the other begins. Its composition is—

Silica	36·56
Alumina..	17·04
Ferric oxide	5·93
Oxide of manganese	0·18
Lime	35·94
Magnesia	1·07
Potash	0·51
Loss by fire	2·00
	———
	99·23

Specific gravity, 3·445.

Spectroscopic Observations made during the Balloon Ascent, September 24, 1874, to Study the Variations and Extent of the Spectral Colours.—M. W. de Fonville.—The author used a spectroscope of Lentz, with a graduated slit arranged so that it was possible to look directly at the sun. Three different observations were made between 1500 and 1000 metres. The blue colour invaded the space occupied by the indigo and violet rays, whilst the red rays appeared the same as on the earth. When the balloon had descended to the upper surface of the clouds the violet and indigo resumed their usual places.

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Liebig's Annalen der Chemie und Pharmacie.
September 19, 1874.

Behaviour of Ozone with Water and Nitrogen.—L. Carius.—The author refers to the contradictory results obtained by previous observers, and to his own papers (*Berichte*, v., 520), showing that ozone is abundantly absorbed by water without any change, that even in presence of nitrogen no peroxide of hydrogen is formed, and that nitrogen is not oxidised in presence of water. The proof that ozone can be absorbed in water is easily furnished by passing at low temperatures into water ozonised oxygen gas, containing not less than 0·5 per cent. The water quickly assumes the smell of ozone, and displays its characteristic reactions. Ozone, as generally obtained, is contaminated not merely with oxygen, but with hydrogen, nitrogen, and its oxides. Hydrogen is indifferent. Free nitrogen, the author has shown, in opposition to the common view, to be likewise without influence. If the oxides of nitrogen meet with ozone in presence of water they are quickly oxidised to nitric acid, thus reducing the quantity of ozone in solution, or in some cases making it disappear altogether. Schœne's recent observation, that in presence of water ozone is converted into common oxygen, is also of importance. A variety of experiments confirmed the author's earlier result that, in presence of water, and at medium temperatures, nitrogen is not oxidised by ozone,

and water is not converted into peroxide of hydrogen. The author holds that solutions of ozone containing not more than 5 volumes in 1000 have so characteristic an odour that they cannot be confounded by any experienced chemist with solutions of nitrous acid, chlorine, chlorous or hypochlorous acid. Sensitive litmus-paper is quickly bleached by concentrated ozone water; dilute solutions produce, before complete decolourisation, a peculiar shade resembling imperfect reddening by an acid. Concentrated ozone water bleaches indigo, colours tincture of guaiacum deep blue, liberates iodine from iodide of potassium, and converts it into iodic acid. Solution of thallous oxide produces a brown precipitate, readily in strong solutions, slowly in weak ones. The author has not succeeded in producing peroxide of silver even with the most concentrated ozone water. What effect the absorbability of ozone in water may have is difficult to say.

Formation of Nitrous and Nitric Acids, and of Peroxide of Hydrogen in Nature.—L. Carius.—Oxides of nitrogen may conceivably be formed from free nitrogen by electric discharges in the air during the oxidation of other bodies in the air; oxidation of nitrogen by means of ozone, and formation of nitrite of ammonia by the evaporation of water in the air. The author finds that the two last-mentioned phenomena are not attended with the production of nitrous or nitric acids. These acids may also be supposed to be formed by the oxidation of ammonia, whether caused by electric discharges, by the presence of alkaline bodies, or by ozone. Experiment showed that the acids in question are actually formed in all these cases.

Dimethyl-Ethyl-Acetic Acid.—A. Wischnegradsky.—This acid, an isomer of capronic acid, is a colourless liquid insoluble in water, possessing a faint odour of the fatty acids. It congeals in a mixture of salt and snow, and becomes liquid again at −14°. Its composition is $C_6H_{12}O_2$.

Palladious Oxide in Hydrogen Gas.—Berzelius observed that palladium with a blue tarnished surface loses its blue colour at common temperatures on exposure to hydrogen gas. The black oxide obtained by heating the nitrate is also immediately reduced without the aid of heat.

Oxidation of the Oxy-Acids of the Fatty Series.—N. Ley and A. Popoff.—A theoretical paper.

Peucedanin and Oroselon.—H. Hlasiwetz and H. Weidel.—Peucedanin is to be considered as the keton corresponding to the aldehyd, orselon.

Preparation of Iodine Substitution-Products According to the Method with Iodine and Oxide of Mercury.—P. Weselsky.—The author has prepared and examined the mono-iodo-salicylic and di-iodo-salicylic acids, iodoxy-benzoic acid, mono- and di-para-oxy-benzoic acids, nitro-di-iodo-phenol, nitro-iodo-salicylic acid, nitro-iodoxy-benzoic acid, nitro-iodo-para-oxy-benzoic acid, ortho-nitro-di-iodo-phenol, and nitro-di-iodresorcin.

NOTES AND QUERIES.

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Carbolic Acid.—Will some correspondent kindly give all the known methods of detecting carbolic acid in solution, the writer being under the impression that he has found a new method of detecting it?—CARBOLIC ACID.

Manufacture of Soda—Ammonia Process.—G. C. will find a paper on this subject in *Dingler's Polytechnisches Journal*, t. ccxii., p. 507 (June, 1874), No. 2, by List, and a translation of it in the *Bulle in de la Societe Chimique*, t. xxii., p. 320 (October, 1874); and I see a translation of an article by List from another source is announced for a future number of the CHEMICAL NEWS. G. C. will also find papers in the *Bulletin*, t. xix., p. 479; t. xx., p. 522; t. xxi., p. 432; and t. xxii., p. 90; and in recent numbers of *Dingler's Journal.*—J. COX.

MEETINGS FOR THE WEEK.

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MONDAY, Nov. 23rd.—Birkbeck Scientific Society, 8. "Water," by J. H. Shirley.
WEDNESDAY, 25th.—Society of Arts, 8. "On School Buildings and School Fittings," by T. Roger Smith.

THE CHEMICAL NEWS.

VOL. XXX. No. 783.

ESTIMATION OF CHICORY IN COFFEE.

By J. R. LEEBODY, M.A.

I HAVE found the following method of applying the colorimetric process for estimating the relative proportions of chicory and coffee in a mixture very convenient.

Take one gramme of the unknown mixture, and one gramme of a standard mixture of equal parts chicory and coffee, and remove all the colouring matter from each sample by repeated extraction with boiling water. Make the cooled extract from each up to the *same* volume (actual volume of no consequence, about 700 c.c. a convenient amount), and filter off a portion for the assay. Put 50 c.c. of the filtered extract from the *unknown mixture* in a Nessler cylinder, and determine by trial how many c.c. of the extract from the *standard mixture*, together with sufficient distilled water to make up to 50 c.c., will give the same colour. Let A c.c. be required, then, assuming the tinctorial power of chicory to be *m* times that of coffee, the percentage (*x*) of chicory in the sample is given by the formulæ—

$$x = A\frac{m+1}{m-1} - \frac{100}{m-1}$$

If *m* were an absolute constant, and definitely determinable (which unfortunately is not the case) this formula would give results of perfect accuracy. Closely accurate results are, however, obtained in practice by taking *m* = 3, when the above formula is written—

$$x = 2A - 50.$$

Modifications in the proportions of the ingredients in the standard mixture, and in the formula employed, will, of course, be required for the examination of samples containing more than 50 per cent of chicory.

Magee College Laboratory, Londonderry,
Nov. 17, 1874.

ON THE DETERMINATION OF IRON IN IRONSTONES.

By A. ESILMAN.

As one accustomed to the analysis of clayband and blackband ironstones, may I offer some suggestions relative to the difficulties which Messrs. Stock and Jack encounter in the determination of iron in such minerals (CHEMICAL NEWS, vol. xxx., p. 221).

Their obstacle seems to be the presence of coaly matter and sulphide of iron, which act during the estimation like proto-salts of iron, and cause high results. I do not know if any other chemist has observed the reaction to which they attribute the reduction of perchloride of iron, and I think its occurrence most improbable. Is it not more likely that the decomposition is simply analogous to that which takes place when easily decomposed sulphides are treated with solution of per-salts of iron, resulting in the reduction to proto-salt of the iron and liberation of sulphur? Massive iron pyrites is only slightly decomposed in this way, but it is very probable that the form of pyrites doubtless occurring in iron ores, similar to coal brasses, is attacked by acid solutions of perchloride of iron at the boiling temperature. All alkaline and earthy sulphides, sulphides of iron represented by the formulæ FeS, Fe_7S_8, and Fe_2S_3, sulphides of zinc, lead, cadmium, &c., and more difficultly sulphide of copper, are decomposed in this manner.

If Messrs. Stock and Jack would boil with *dilute* hydrochloric acid the finely powdered ironstone, *invariably* filter off the insoluble matters, and determine the iron by the bichrome method in a solution nearly warm, and not boiling, their difficulties would vanish. A fresh portion, calcined, and fused with bisulphate of potash, gives the total iron in a soluble form to hydrochloric acid. I have invariably found fusion with bisulphate capable of freeing siliceous matters from iron in less time and at lower temperatures than fusion with alkaline carbonates.

Reduction of peroxide of iron by stannous chloride seems to me objectionable where there is organic matter present. In the first place it must be done in a highly concentrated acid solution, when each drop taken out to ascertain the progress of the reduction represents a notable quantity of the substance under examination; and secondly, it is difficult to remove excess of the reducer. A much more preferable plan to me seems to be the addition of ammonia and sulphide of ammonium in excess, then ebullition with excess of hydrochloric acid to expel the sulphuretted hydrogen, then filtration from sulphur. This does not take long time and is very exact.

Under any circumstances titration of the iron by bichrome at the boiling temperature is quite unnecessary. A cold solution may indeed be used, if the final reactions be not too hurriedly noted, while at a warm temperature the organic matter dissolved from the coaly matter of an ironstone does not interfere. For this reason, also, Dr. Penny's method is often preferable to the permanganate process, which a writer in this weeks CHEMICAL NEWS enthusiastically terms "classical."

Manchester, November 21, 1874.

RESEARCHES ON THE COLOURING MATTERS OF MADDER.

By A. ROSENSTIEHL.

SINCE the publication in 1864 of the researches of MM. Schützenberger and Schiffert on commercial purpurin, it has been generally admitted that four colouring matters exist in madder—alizarin, pseudopurpurin, purpurin, and a hydrate of the latter. The author has prepared these bodies in the state of purity in order to take account of their part in dyeing. He has found that the two latter bodies are formed at the expense of the pseudopurpurin under the conditions of industrial treatment. He has studied the products of the reduction of purpurin, to regenerate it from these products, and finally to obtain two of its isomers, one of which differs from it very little in tinctorial properties, and has been obtained synthetically, taking benzoic acid as a point of departure. Alizarin prepared by the procedures described in books is not pure. After sublimation it must be re-crystallised a great many times from alcohol, until a dyeing experiment proves the identity of two consecutive mother-liquors. To abridge these operations he heats commercial alizarin for some hours to +200° C. with water containing a little caustic alkali. The foreign matters are totally destroyed, the alizarine only partially. He then purifies the crude result of this operation by crystallisations. Pure alizarin stirred up in distilled water dyes mordanted tissues very imperfectly. The mordants do not become saturated unless an aqueous solution of carbonate of lime is added to the dye-bath. The effect is at its maximum when the quantity of lime corresponds to a monocalcic compound of alizarin. A larger proportion is hurtful from the formation of a bicalcic lake which does not dye. Aluminous mordants upon tissues not oiled take a shade much nearer violet than with alizarin prepared according to known methods. It is the O−1 violet-red of Chevreul's chromatic circles, and very far from what is known as a madder-red. Iron mordants dye a shade which appears to me to be near 1 violet blue lowered $\frac{1}{10}$ to $\frac{2}{10}$. This particular shade of violet, which is in great request, as

well as the resistance of the dye to light and to boiling soap-lye, and its behaviour as a dye with distilled water, distinguish alizarin from the other colouring matters of madder.

Pseudopurpurin, discovered by MM. Schützenberger and Schiffert, forms with alizarin the bulk of the colouring matter contained in madder. It dyes only in distilled water. An amount of carbonate of lime equivalent to a monocalcic lake converts it entirely into an insoluble compound, which carbonic acid is unable to decompose. Aluminous mordants take shades bordering upon those given by alizarine; iron mordants take a violet-grey (5 violet blue $\frac{3}{10}$ or $\frac{4}{10}$). These colours are not brightened by soap baths, but quickly degraded, which distinguishes them from the other madder dyes. Pseudopurpurin is very unstable. Boiling alcohol at 90 per cent, as well as boiling distilled water transforms it in three hours into a mixture of purpurin and of its hydrate. On comparing the formulæ of these two bodies, $C_{14}H_8O_6$ (pseudopurpurin) and $C_{14}H_8O_5$ (purpurin), it appears that the water and the alcohol effect a true reduction, which in the case of water especially can only take place at the expense of a part of the pseudopurpurin itself. The reduction goes farther; there being always simultaneously formed a small portion of purpuroxanthin, $C_{14}H_8O_4$, an isomer of alizarin, two atoms of oxygen being withdrawn without the concourse of any foreign reducing agent.

This remarkable reduction may be effected at temperatures below 100° if we operate upon crude pseudopurpurin, or upon madder (previously washed) in presence of acidulated water, or an aqueous solution of alum, which is a good solvent for this substance. In this case, it is probably one of the proximate principles of madder which effects the reduction.

According to the above, pseudopurpurin cannot exist in the commercial derivatives of madder which have undergone the action of hot acidulated water, such as garancin, garanceux, and the various extracts of madder. It is only found in madder, fleurs de garance, and commercial purpurin, as prepared by the process of E. Kopp. It is always accompanied by the products of its reduction, purpurin, its hydrate, and purpuroxanthin. On account of the facility with which it forms an insoluble lime lake, and its want of resistance to clearing agents, pseudopurpurin plays no part in dyeing, and only becomes useful by its conversion into purpurin. Nevertheless it has not been without its applications. It is the colouring matter of madder-lake, which gives very bright rose shades.

Purpurin was obtained by MM. Schützenberger and Schiffert by heating pseudopurpurin to +200° with alcohol, or by sublimation. In either case there is destruction of a considerable part of the substance. We have seen above that the transformation may be accomplished by reactions less energetic, and with a smaller loss of material. Purpurin readily dyes mordanted stuffs in distilled water. The addition of a quantity of lime corresponding to a monocalcic lake is not hurtful, but a larger proportion leads to the formation of an insoluble tricalcic lake which does not dye, and which carbonic acid decomposes with great difficulty.

The shades obtained with purpurin differ much from those produced by the two colouring matters above mentioned. Alumina gives 4 violet-red; the red as almost as violet as, and at the same time brighter than, that produced by alizarine. Iron mordants give 2 violet-blue $\frac{3}{10}$.

These shades are not stable; the operations of *avivage* and soaping rob them of their violet tone; the red becomes o or 1 red of the chromic table, but has much ustre. The violet is weakened and dulled.

He has obtained hydrated purpurin (Schützenberger's orange matter) on precipitating with an acid a solution of purpurin in an alkali or in alum water. With calcareous water it behaves almost like purpurin. The shades which it dyes resemble those of purpurin after they have passed through a soap bath. It appears as if the transformation of purpurin into its hydrate takes place upon the fibre. The

reds and roses produced by these bodies are as solid as those obtained from alizarine, but they resist light less perfectly.

The different facts announced explain what takes place in dyeing and clearing madder colours. The madder-red and the fine rose produced with fleur de garance cannot be obtained with alizarin alone, as the concurrence of purpurin or of its hydrate is indispensable.

By treating pseudopurpurin and purpurin with reducing agents, we never obtain alizarin, but its isomer purpuroxanthin. The conversion of purpurin into alizarin under the action of heat, though admitted by several chemists, especially M. Bolley, did not succeed.—*Comptes Rendus.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.
Thursday, November 19th, 1874.

Professor ODLING, F.R.S., President, in the Chair.

THE names of the visitors having been announced, and the minutes of the previous meeting read and confirmed, the following names were read for the first time :—Messrs. E. Wethered, W. H. Symons, W. Wade Hyde, J. A. Kendall, D. Bendix, J. McDougall, H. Penley Harris, G. Phillips, and E. Sonstadt. For the third time—Messrs. F. W. Bayley, James Forbes, Jun., Edwin Lawson Koch, M.D., Frederick Baden Benger, and Louis Siebold, who were balloted for and duly elected.

The first paper, "*On the Action of Organic Acids and their Anhydrides on the Natural Alkaloids (Part II., Butyryl and Benzoyl Derivatives of Morphine and Codeine)*," by G. H. BECKETT and C. R. A. WRIGHT, D.Sc., was read by the latter. By the action of butyric acid and butyric anhydride on codeine, *dibutyryl codeine*, $C_{36}H_{40}(C_4H_7O)_2N_2O_6$, is formed; it does not crystallise, but its hydrochloride does. On heating codeine to 130° C. for four hours with benzoic anhydride, a crystalline base, *dibenzoyl codeine*, $C_{36}H_{40}(C_7H_5O)_2N_2O_6$, is obtained; the hydrochloride crystallises with difficulty. The action of butyric acid on morphine yields a crystalline *dibutyryl morphine*, $C_{34}H_{36}(C_4H_7O)_2N_2O_6$, whilst excess of butyric anhydride, as in the case of the acetyl compounds, gives *tetra-butyryl morphine*, $C_{34}H_{34}(C_4H_7O)_4N_2O_6$; neither this base nor its hydrochloride are crystalline. The author has also prepared *acetyl-butyryl morphine* and *acetyl-benzoyl morphine.*

It would seem that, when these bases are boiled with water, the acetyl compounds decompose more readily than the butyryl ones, and these, again, than the benzoyl ones. In conclusion, he tendered his thanks to Messrs. Macfarlane and Co., of Edinburgh, for the large quantities of pure bases they had presented to them for the purpose of making these experiments.

The PRESIDENT said he was sure the Society would appreciate the liberality of Messrs. Macfarlane, and at the same time congratulate the authors on the successful results of their investigations. It would seem probable that the hydroxyl was acid rather than alcoholic, since the more powerful acid radicals in the new bases were more easily displaced by treatment with water than the weaker ones. Could Dr. Wright suggest any reason why morphine gave tetra derivatives, whilst codeine gave only di derivatives?

Dr. WRIGHT replied that experiment had shown that morphine and codeine were related in the manner shown by the formulæ—

$$C_{34}H_{34}N_2O_2 \begin{cases} OH \\ OH \\ OH \\ OH \end{cases} \text{ and } C_{34}H_{34}N_2O_2 \begin{cases} OH \\ OH \\ O(CH_3) \\ O(CH_3) \end{cases}$$
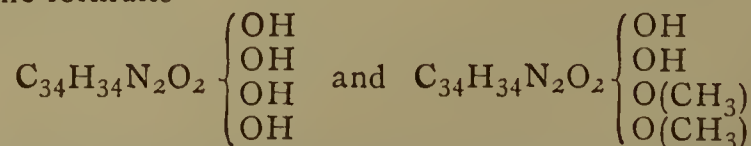
Since the former contains 4OH, and the latter only 2, morphine may yield tetra derivatives, whilst codeine only gives

di derivatives. The nitrogen in the base, moreover, is triad, and, as it may become pentad, we find these bases will combine with ethyl-iodide, yielding a new series, an account of which he hoped shortly to lay before the Society.

Professor W. K. CLIFFORD then made a communication "*On General Equations of Chemical Reactions.*" The speaker said that any one who had been occupied in speculating on the causes of physical phenomena would occasionally come to a point of junction, as it were, between chemistry and physics; such a point was the kinetic theory of gases. From the physical properties of gases, we know that a given volume of each gas under similar circumstances contains the same number of molecules; moreover, certain phenomena which might be called physical were explained by some chemists in one way, and by some in another. For instance, on passing an electric spark through a mixture of equal volumes of hydrogen and chlorine, a product is obtained occupying the same volume as the original mixture, and this is generally explained by saying $H_2 + Cl_2 = 2HCl$, the molecule of hydrogen and of chlorine being each made up of two equal and similar structures; whilst Sir B. Brodie in his hypothesis, expressed thus, $a + a\chi^2 = 2a\chi$, assumes that the chlorine molecule $a\chi^2$ contains hydrogen in it. These differences had led the speaker to consider the evidence in favour of the two hypotheses, and, although he found that chemical phenomena could be simply explained by the first, yet there was no evidence to exclude the second. He had, therefore, endeavoured to find a general equation which must include all hypotheses, and which would express merely the facts; thus, 1 vol. + 1 vol. = 2 vols., or $a + b = 2c$, expresses merely the results of experiment. Suppose a and b to be complex, and to contain some factor common to both a and b, then their sum, $p + q$, must be an even number, since in the product, $2c$ is an even number, and the part in common must be equally distributed over the whole number of molecules in the product (since the molecules in $2c$ are equal to the sum of those in a and b); again, if $p + q$ is an even number, $p - q$ must also be even, so that, if there is any common constituent in both a and b, the number in which it exists in a over that in b is an even number. Express this by x, then the other factors, yy and zz, not common to a and b, must necessarily be even numbers. The equation $a + b = 2c$ can, therefore, be written $xyy + xzz = 2xyz$. There is no supposition involved in this equation, which merely represents facts, and any reaction where there is no reduction of volume, such as $H_2 + Cl_2 = 2HCl$, must be represented by it. It will be seen that it contains both the hypotheses previously alluded to.

In the equation $a + 2b = 2c$, the particular case of which is $O_2 + 2H_2 = 2OH_2$, what is common to a and b must be even, and what is not common must be contained an even number of times in a; the equation therefore becomes $xxyy + 2xz = 2xxyz$, which conclusively proves oxygen to have a double structure. By parity of reasoning, the most general form of the equation $a + 3b = 2c$, of which a particular case is $N_2 + 3H_2 = 2NH_3$, is $xyy + 3xzz = 2xxyzzz$.

If now we assume that equal volumes of nitrogen and oxygen combine to form the compound NO, or that $N_2 + O_2 = 2NO$, an equation of the form $xyy + xzz = 2xyz$ ($a + b = 2c$), then, since b, or xzz, is known to have a double structure, O_2, x must be double, and xyy, or nitrogen, must be double, N_2; and as $xyy + 3xzz = 2xxyzzz$ ($a + 3b = 2c$), therefore, xyy, or a, which represents the hydrogen, must have a double structure, H_2. The equations in general use are thus proved to represent facts, and are not merely hypotheses.

The PRESIDENT said they were all much indebted to Professor Clifford for showing us that the form of equation in common use may be established by facts, independent of hypothesis. In writing the equation $H_2 + Cl_2 = 2HCl$, an assumption seems to be made that hydrogen and chlorine have nothing in common, and probably the majority of chemists are not generally aware that they are in this case making any assumption whatever.

Dr. WRIGHT said there was one thing assumed in stating the mathematical hypothesis, and that was the existence of molecules, which was the point in dispute. He would like to know whether all the phenomena known to physicists could be accounted for by the molecular hypothesis; for instance, whether there were recorded observations of any law of force which would account for diffusion, dilation, viscosity, cohesion, &c.?

Mr. J. A. R. NEWLANDS said, the fact that the combination of 2 vols. of hydrogen with 2 vols of chlorine produced 4 vols. of hydrochloric acid was, of course, well explained by supposing that the hydrogen molecules and the chlorine molecules consisted of double atoms. Still, a mathematical objection might be made to the formula $H_2 + Cl_2 = 2HCl$, on the ground that it was difficult to conceive that one molecule or double atom of hydrogen, or of another element, could by itself occupy any space at all beyond that actually filled by it, and therefore to speak of the volume of one molecule was not correct. Whatever objections might be urged against the atomic view of matter, there could be no doubt that the idea of atoms was an exceedingly useful aid both to teaching and research.

After some remarks by Dr. PIKE and Mr. FRISWELL, on the spectral lines common to the elements and to some of their compounds,

Professor CLIFFORD replied that he had approached the subject from the physical side, and there was no doubt that the kinetic theory of gases, which is merely an expression of facts in another language, amounts to an absolute demonstration of the existence of molecules. For diffusion and viscosity, very exact laws had been deduced, which were in accordance with the kinetic theory. This theory was only just beginning to be applied to liquids, but for gases it had ceased to be of the character of an hypothesis.

A paper "*On Propionic Coumarin and its Derivatives*," by W. H. PERKIN, F.R.S., was then read by the author. This compound was prepared by acting on the hydride of sodium-salicyl with propionic anhydride obtained from ethylic cyanide: after washing with water and distillation, it was crystallised from alcohol. It forms beautiful transparent oblique prisms, having the composition $C_{10}H_8O_2$. It melts at 190°, and possesses an odour almost identical with that of ordinary acetic coumarin. The β-*bromo-coumarin*, $C_{10}H_7BrO_2$, is obtained on substituting hydride of sodium-bromo-salicyl for the sodium-salicyl in the above-described process, and also on adding excess of bromine to propionic coumarin. It contains the bromine in the C_6 group, and crystallises in long, thin needles, which melt at 146° and dissolve easily in boiling alcohol. The β-*dibromo-coumarin*, $C_{10}H_6Br_2O_2$, is obtained on heating propionic coumarin to 150° C. with twice its weight of bromine dissolved in carbon disulphide. Exposed to the vapour of bromine, propionic coumarin absorbs it, and forms a viscid liquid, which appears to be a dibromide, corresponding to the dibromide obtained from ordinary coumarin; whilst with fuming sulphuric acid, it yields sulpho-propionic coumarilic acid. The baric salt forms small brilliant crystals of the formula—

$$C_{20}H_{14}O_4BaS_7O_6.10aq.$$

The PRESIDENT having thanked the author,

Professor A. H. CHURCH read a communication "*On the Composition of Autunite.*" From the results of the author's analysis, autunite, as it exists in the unaltered crystals, is—

$$\left. \begin{array}{r} U_2O_3 \\ CaO \end{array} \right\} P_2O_5, 10H_2O$$
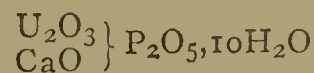
when dried *in vacuo*, however, it loses eight molecules of water, and becomes—

$$\left. \begin{array}{r} U_2O_3 \\ CaO \end{array} \right\} P_2O_5, 2H_2O,$$
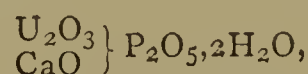
the remaining two molecules of water not being driven off at 100° C. The corresponding mineral, torberite, with

which it was long considered to be isomorphous, has the formula—

$$\left.\begin{array}{c} U_2O_3 \\ CuO \end{array}\right\} P_2O_5, 8H_2O \; ;$$

and when dried at 100° C.—

$$\left.\begin{array}{c} U_2O_3 \\ CuO \end{array}\right\} P_2O_5 \; 2H_2O.$$
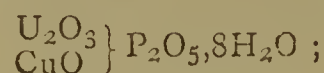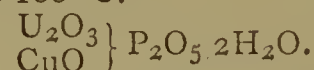
It does not lose water *in vacuo.*

The thanks of the Society having been given to the author by Dr. ODLING,

A paper was read "*On the Action of Bromine on Proto-catechuic Acid, Gallic Acid, and Tannin,*" by J. STEN-HOUSE, F.R.S. The author finds that, although at ordinary temperatures the action of excess of bromine on proto-catechuic acid only produces mono-bromo-protocatechuic acid, $C_7H_5BrO_3$, yet at 100° carbonic anhydride is elimi-nated and tetra-bromo-pyrocatechin, $C_6H_2Br_4O_2$, is formed. Similarly, the action of bromine on gallic acid gives rise to dibromo-gallic acid at the ordinary temperature ; whilst at 100°, with excess of bromine, this is decomposed, and tribromo-pyrogallol, $C_6H_3Br_3O_3$, is formed, with elimina-tion of carbonic anhydride. This is the more remarkable, as neither proto-catechuic acid nor gallic acid are decom-posed when heated alone to 100°. Commercial bromine and ordinary tannin, when heated to 100° with excess of bromine, likewise yield bromo-pyrogallol ; the small amount of water naturally present in the materials being sufficient to convert the tannin into gallic acid, which is then further acted on by the bromine. The paper contains details of the best process for preparing protocatechuic acid.

The meeting was finally adjourned until Thursday, De-cember 3rd, when there will be a communication " On the Formulæ of the Alums," by Mr. S. Lupton.

PHYSICAL SOCIETY.
Saturday, November 21st, 1874.

Dr. J. H. GLADSTONE, F.R.S., President, in the Chair.

AT this meeting, held at the Science Schools, South Ken-sington, eight new members were elected.

Professor MACLEOD made a communication " *On a Simple Apparatus for Showing Internal Resistance in Battery Cells.*" Two tubes about half a metre long, and one of which is twice the diameter of the other, are closed at their lower ends with corks. On the corks, and within the tubes, rest two discs of platinum foil, connected with binding-screws by platinum wires passing through the corks. The platinum plates are covered with small quan-tities of chloride of silver, and the tubes are filled with a solution of chloride of zinc. Each tube is provided with a disc of amalgamated zinc soldered to a long copper wire, which is well covered by an insulating material. The discs are cut so that they nearly fit the tubes, one being exactly double the diameter of the other, and therefore ex-posing four times the surface to the action of the liquid. On connecting the terminals with a galvanometer, the current will be found to increase as the distance between the zinc and platinum plates is diminished by lowering the zinc plate in the tube. In order to obtain the same de-flection of the galvanometer by the narrow cell, the dis-tance between the plates must be one-fourth of the dis-tance between those of the larger one.

The apparatus may also be used to show that opposed cells of the same kind will not produce a current. For this purpose, the platinum plates are connected together, and the two zinc plates joined to the galvanometer. No current will flow, whatever the distances between the plates.

A communication was also made to the Society by Mr. JAMES B. HAMILTON, "*On a New Class of Stringed Instru-ments,*" of which he is the inventor, and in which the special advantages of the pianoforte and of the organ are combined.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.
Ordinary Meeting, October 20th, 1874.

EDWARD SCHUNCK, Ph.D., F.R.S., &c., President, in the Chair.

MR. WILLIAM H. JOHNSON, B.Sc., showed two remarkable pieces of iron cinder from a furnace in which iron is re-heated. The samples showed on one side small dark prismatic crystals, which appeared to have been formed in a cavity of the cinder as it cooled in the cinder bogie. The reverse side of one of them had formed the wall of a second cavity ; its surface was, however, smooth, black, shining, and studded all over with the sides of oblong jet-black crystals, unusually iridescent. He remarked that probably these crystals were fayalite, an iron chrysolite, a mineral found in the Mourne mountains in Ireland, which is sometimes iridescent, and whose chemical composition is represented by the formula Fe_2SiO_4. They are the more worthy of notice from the rare occurrence of crystals in mill-furnace cinder.

"*On a Colorimetric Method of Determining Iron in Waters,*" by Mr. THOMAS CARNELLEY, B.Sc. Communi-cated by Professor H. E. Roscoe, F.R.S.

GLASGOW PHILOSOPHICAL SOCIETY.
(CHEMICAL SECTION).
Opening Meeting, November 9th, 1874.

Abstract of Address by the President, Mr. EDWARD C. C. STANFORD, F.C.S.

THE opening remarks were devoted to a notice of the life and scientific labours of the late Dr. Thomas Anderson, F.R.S.E., Professor of Chemistry in the University of Glasgow, and a former President of the Philosophical Society, and afterwards of the Chemical Section. Then, referring to the recent meeting of the Social Science Association in Glasgow, and to Dr. Lyon Playfair's presi-dency of the Health Section, Mr. Stanford said it is quite time that the aid of chemical research should be called in to give its assistance. It is remarkable how little we know, chemically, of the air we breathe, the soil we live upon, the water we drink, and the food we eat. The chemistry of hygiene is quite in its infancy. Pettenkofer avers that in all really healthy houses we virtually live out of doors, the walls being largely pervious to air ; and he shows that, where these walls are saturated with water, they become impervious to air, and therefore unhealthy. It has been found that, to keep the air pure in houses, a ventilation is necessary of more than 2100 cubic feet per head per hour. When the model Hospital la Ribasière was erected in the Faubourg Poissonière, it was furnished with artificial ven-tilation ; 700 cubic feet of air per head per hour was judged ample for all requirements. At this rate, the air in the wards was quite foul, and it was not until 2120 cubic feet were used that the hospital was pure. The rate now recommended is as follows:—

		Cubic feet per head per hour.
In hospitals for ordinary cases ..		2120 to 2470
" " wounded		3530
" " epidemics		5300

Pettenkofer shows that most of the ventilation of a room is through the walls, and we are apt to forget how extremely porous to gases these septa generally are. He reckons the average rate per square yard at about 7 cubic feet, or 43 gallons, per hour. He employs carbonic acid measure-ments in these researches, and the large wall ventilation shows that smaller houses have more ventilation, in pro-portion to their size, than large ones. In earth hovels, the ventilation is about double the average rate. Pettenkofer's researches generally are most interesting ; and when we

consider the number of disease germs often in the air, it must be confessed that our air chemistry is sadly at fault.

Turning to the soil we dwell on, we should not forget that our houses, if well drained, are practically built on air, or rather on soil full of air; and we know that, if this soil be full of water, our health suffers. The porosity of soil to air and gases is so remarkable, that Pettenkofer relates cases of "persons poisoned and killed by gas which had to travel for 20 feet under the street, and then through the foundations, cellar-vaults, and flooring of the ground-floor rooms." The porosity of the soil has an important effect on the decomposition of corpses. It has been shown that, in a porous soil, the body rapidly decays, whereas in a clay soil it is preserved for long periods. This shows the necessity for proper investigation before deciding on sites for cemeteries, unless we are to make our relations into gas, and thus "live by the light of our ancestors," as Dr. Lyon Playfair has suggested.

Turning to the water we drink, there is still, unfortunately, great difference of opinion as to the proper composition of good drinking water. The term "previous sewage contamination," which has been introduced, is misleading, because some of the deep well-waters will show large amounts of nitrates without a trace of organic matter; and it does not follow that these nitrates have been derived from sewage. On the other hand, the celebrated Loch Katrine water contains nearly as much organic matter as that of the best London supply, and there is no doubt that, to be entirely free from suspicion, this organic matter should be separated by filtration. Professor Wanklyn's method of water analysis has given great facilities for easily assessing the value of a drinking-water, and his manual on the subject should be in the hands of all analysts, for the analysis of drinking-waters is now constantly required. The amount of ignorance prevailing on this subject is extraordinary. It is impossible to convince healthy villagers that they have long been in the habit of drinking a dangerous water, and the analysts must always expect great opposition to his statements. In one case in Scotland, where a good water supply was voted against, one voter said that the engineer knew nothing about it, because he had got one 6-inch pipe to supply two 4-inch pipes, which was impossible; whilst another voter said the engineer could not have laid down the pipes right, because he had not measured the ground, forgetting that the ordnance map very accurately supplied him with the data. How can such people judge of the analysis of a water? The question of a water supply naturally leads to the consideration of that supply after our houses have fouled it into sewage. If we have only to deal with the water supply before and after it leaves our houses, we deal with a definite, fixed quantity, comparatively so small that it is easily dealt with. At present, however, the sewage of towns contains also that very variable item, the rainfall; and whenever that has to be included, it upsets all systems of filtration, irrigation, &c., because in time of floods it must be run to the nearest river. If the water-closet system is to be continued, it must be carried out in a separate system of impervious sewers; and, if anything is to be done with the sewage, that result must be attained before the assistance of chemists is called in. When the value of the material to be utilised is only one penny per ton, we must leave the towns to the tender mercies of the engineers. As for irrigation, farmers in the west of Scotland do not, as a rule, complain for want of water, and they would doubtless prefer their manure dry, certainly not in that extraordinary state of dilution which characterises the Glasgow sewage, which is only about two-thirds the average value. Bad as the river Clyde is, more processes have been brought before the authorities in Glasgow than anywhere else. Three of these are at present little known elsewhere, viz., Mr. Chapman's method of utilising the urine of the city, the Hoey "limited" water-closet system, and the carbon closet system, all of which have been reported upon by Dr. Wallace, F.R.S.E., F.C.S., to the Police Board of Glasgow. They are all processes of interception, and are all steps in advance, because they all utilise what has hitherto been waste and polluting material. Any method of keeping valuable, though polluting, matter out of the sewers ought to be encouraged, because, by so much, it lessens the difficulty. The question will probably resolve itself ultimately into this:—That all polluting material must be kept out of the sewers; manufacturers must look after their own pollutions, and householders after theirs, the town authorities looking after the rainfall and streets. Taken at the outlet, the question is extremely difficult; taken at the house, it is easy; and house-to-house purification may become the real solution of the difficulty.

Before leaving the subject of sewage, Mr. Stanford referred to that of disinfection, and said—The public appear to me to be altogether on the wrong track. Chloride of lime and carbolic acid are making our cities everywhere offensive. Both of these substances act well if concentrated; they act like the clean, sharp cut of the surgeon's knife, but they do not bear dilution. When dilute, both have been found actually to favour the growth of germs, and it cannot be too generally known that the universal use of these substances to overcome bad smells is simply substituting one stink for another. There is nothing more difficult than the purification of infected air. A good disinfectant should not itself foul the air it pretends to purify. The only true way to disinfect is to prevent decomposition. We have several old antiseptics that ought not to be forgotten. Dr. Angus Smith has shown that common salt is much cheaper and better than these popular and odoriferous remedies. I have strongly urged the use of chloride of calcium for this purpose—it is the cheapest of all disinfectants, and can be got in enormous quantities.

The food question leads us to the consideration of the Adulteration of Food Act. This has given rise to a large number of appointments to chemists as local analysts. Unfortunately, our science has not hitherto come well out of the sudden demand made on it. In the first place, the appointments were so numerous that we had not the men, and there is no doubt that our processes for the detection of adulterations in food were very crude and immature. These, however, are merely temporary difficulties, as Wanklyn's series of food researches has shown that milk, tea, coffee, and cocoa can be accurately tested. But these are only a small portion of what comes under the public analyst's attention. The position not only requires high analytical ability, but likewise a large knowledge of the trades in food products, &c. Speaking of commercial analysis, Mr. Stanford said:—"The great discrepancies between different analysts which have given rise to the very objectionable titles of 'high' and 'low' chemists, have been a scandal to our science." With a view of making some reform, we agreed to petition the British Association to appoint a Committee to inquire into the methods of testing potash, salts, and phosphates —those being the substances in which we had noticed the greatest variation—and if possible arrive at standard processes of general application, and agree as to statements of analytical results. The Newcastle Chemical Society supported us in our application; and they added copper, soda, and sulphur. As showing how strongly the chemists felt in that large centre of manufacturing chemistry, they also passed the following resolution:— "And that this Society is of opinion that the sub-committee suggested might also usefully inquire into the question of instituting a professional examination for a diploma, without which no person should be legally qualified as a public analyst." This resolution was soon after given effect to in a meeting of public analysts, held in London, under the presidency of Dr. Redwood, and where resolutions were passed almost identical. These chemists had been roused to action by the suggestion to the Committee on Adulteration that the Inland Revenue Laboratory should be the ultimate court of appeal in disputed cases. The Adulteration of Food Act has done much good, and when it is regulated, as it will be, by the

analyses of accomplished chemists, working by accurate chemical processes, and not by microscopic medical men, it will be a great boon to the nation. The British Association appointed a committee, with a grant of £10, to meet our wishes, and inquire into potash salts and superphosphates. It consists of Messrs. Dewar, Fletcher, Allen, and Stanford, with power to add to their number, and Mr. Allen as secretary.

Referring to the progress of original research in chemical science, Mr. Stanford noticed the artificial production of vanillin, and proceeded to say—The Society of Germany Ultramarine Manufacturers have offered a prize of one thousand imperial marks for the best work on the constitution of ultramarine, and the exact form of combination in which the sulphur exists. If any of our members think of taking up this research, I would point out that many of the sulphur compounds with alkalies are undefined. No perfect explanation has yet been given of the curious colour changes in the evaporation of caustic soda from dark red to green and blue, before actual fluxing. I would also remind those who want " something to tussle with," that artificial quinine is yet undiscovered. We know very little about the real causes of nitrification. I have shown that neither charcoal nor earth oxidises ordinary nitrogenous organic matter, and that the lattter simply produces decay and evolution of ammonia. In solution, the action of various filtering media on nitrogenous organic matter is very imperfectly understood. This much may in the meantime be said on the subject, namely, that filtration through porous bodies tends to convert the nitrogen into ammonia rather than, as is generally supposed, into nitric acid. Those engaged in the manufacture of chemicals have enough to do now to hold their own against foreign competition. Where elaborate chemical processes are required, as, for instance, in the preparation of the natural alkaloids, we cannot compete with the German manufacturers, who, with the exception of quinine and morphia, have this class of manufacture mostly in their own hands. We cannot secure sufficiently educated workmen for this high class of work. One of the most important contributions from the laboratory to medical science is chloral hydrate, the first narcotic artificially produced. This substance, for which there is now an enormous demand in medicine, is almost all imported. Our manufactures in this and in the alkaloids are also handicapped by the large duty payable on alcohol in this country. We can obtain methylated spirit free of duty for manufacturing purposes, but unfortunately this is an impure spirit, and unsuitable for the preparation of pure chemicals. As the use of this spirit entitles the excise officer to visit the works, it would be well to allow the use of pure spirit in all chemical works under certain restrictions.

Mr. Stanford next referred to the manufacture and large consumption of bromide of potassium in medicine, the large imports from the German potash mines, the extraction of iodine from the nitrate of soda liquors of Chili, the importance of potash in agriculture, and then enlarged upon recent attempts to improve upon Le Blanc's process for the manufacture of carbonate of soda. The most promising improvement, he said, is that of Hargreaves and Robinson, who decompose the chloride of sodium direct by sulphurous acid from the pyrites burners. They thus do away with the wear and tear of vitriol chambers, and produce sulphate of a high degree of purity. Large works are being erected in Lancashire for this process. One of the new improvements in manufactures that appear to me very valuable is Morfit's method of making soaps direct from the combination of the fatty acid with the carbonated alkali, thus making a soap direct without the expense of causticising the alkali, and the prolonged boiling necessary to decompose the oil or fat employed, and the loss of the whole of the glycerine. In our alkali manufactures many improvements have been introduced. One of the most notable, perhaps, is the revolving black-ash furnace, which economises labour.

Labour and fuel are very important elements in the manufacture of soda-ash, the raw material being low in value. In potash working the waste is the most important consideration, the raw material being expensive. The utilisation of waste is still the most important of chemical questions. Weldon's process of manganese recovery, and Mond's process of extraction of sulphur are valuable steps in the right direction, and each can be worked with a profit; but they are only steps, and neither can yet be considered perfect. I cannot leave this question without referring to the process of one of our members, Mr. Mactear, which appears to me a great improvement, and is now at work at St. Rollox. He employs the sulphurous acid gas from pyrites for the oxidation of the yellow liquors, which are then decomposed by muriatic acid—thus obtaining both the sulphur of the waste, and that of the pyrites. Mr. Mactear is enabled also to take advantage of the natural rainfall, and simply use the liquor draining from the very large stock of waste which Messrs. Tennant and Co. have in reserve. Manufacturers may expect next year an amendment of the Alkali Act. I do not know if the 5 per cent allowance of hydrochloric acid escaping will be reduced, but I think it ought to be. Half this would appear to me not unreasonable. Certainly sulphurous acid will be included in the new law, and it ought to be, for I am convinced from personal observation that sulphurous acid is more destructive to crops than hydrochloric acid. Under the new laws we shall have to be more and more particular in our chimney testing. It is unfortunate that although we can easily determine the gases in a cubic foot of the air passing out of our chimneys, it is exceedingly difficult to ascertain exactly how many cubic feet pass per minute. I have tried every apparatus yet introduced, but none appear to me quite trustworthy and satisfactory in working on such a variable rate as that of a chimney.

Mr. Stanford then briefly described the testing apparatus used in his own works, and concluded by referring to the Technical College movement, and the prospect of a better class of workmen being provided.

CORRESPONDENCE.

GASEOUS VOLUMES AND SPECIFIC GRAVITIES.

To the Editor of the Chemical News.

SIR,—I regret to find that an erroneous *datum*—the specific gravity of oxygen (which, in absence from my library I took from a borrowed treatise on chemistry apparently faithful)—should have led to so great an encroachment on your columns. It must be regarded only as an unlucky misprint; and I am much obliged to your three correspondents for their correction of the error, the more so as it has enabled me to prove that the expansion of the volume due to the conversion of CO_2 into CO is perfectly compensated by the contraction of volume consequent on the combustion of CO, the result (of importance to me) being that heat is neither lost nor gained. Perhaps I may be excused for my oversight when I find that each of the three gentlemen gives a different number, while a fourth gives me another number differing from the rest, though all agree up to the first decimal place.

Addressing myself principally to Mr. Routledge's letter, I must say that it is new to me to hear it said " that mathematicians are happy only in applying the deductive methods of their science, and careless about the verification of their data." I have always believed, and I hope with good reason, that a training in the exact methods of the physical sciences leads to habits of the widest and strictest induction of facts, as well as to deductive accuracy; and I think that the philosophy of chemistry would not be the loser if its professors generally had such a training.

Mr. Routledge has altogether misconceived the object of the algebraical statement which he criticises. That object was to apply a test, a *reductio ad absurdum*, to the statement "that the volume of the CO generated by the conversion of CO_2 by union with C is double of the aggregate volumes of CO_2 and C." This I had to combat, and I have done so successfully, for the ratio of the volumes is that of 3 to 4, even as shown by the molecular-volume notation. Thus, taking $CO_2 + C = 2CO$, the ratio is—

$$1 \text{ mol. } CO_2 + \tfrac{1}{2} \text{ mol. } C : 2 \text{ mols. } CO$$
$$= 2 \text{ mols. } CO_2 + 1 \text{ mol. } C : 4 \text{ mols. } CO$$
$$= 4 \text{ vols. } CO_2 + 2 \text{ vols. } C : 8 \text{ vol. } CO$$
$$= 2 \text{ vols. } CO_2 + 1 \text{ vol. } C : 4 \text{ vol. } CO$$
$$= 3 : 4 = 1 : 1\tfrac{1}{3},$$

being an *expansion* of $\tfrac{1}{3}$ on 1, as I have determined by my formulæ with the now-corrected value of the density of oxygen.

If we take $CO + O = CO_2$, we obtain, similarly, the ratio 2 vols. $CO + 1$ vol. $O : 2$ vols. CO_2, or as $3 : 2 = 1 : \tfrac{2}{3}$, being a *contraction* of $\tfrac{1}{3}$ on 1.

As Mr. Routledge is so unsparing a critic, it is not unfair to ask whether he is always able to use correctly his own tools? He brings out the density of carbon vapour as 0·414, saying that, "when the equation is written in accordance with the statement that 1 vol. of CO_2 added to (combined with) 1 vol. of carbon vapour forms 2 vols. of CO, the solution gives $x = 0.414$." Now, this is only *half* the correct number, 0·828. The statement should have been, 1 vol. $CO_2 + \tfrac{1}{2}$ vol. C. forms 2 vols. of CO, the molecular formula of carbon being C_2, not C.

The other two wrong statements made to me remain uncorrected, but, as I have now corrected them for myself, I need not dwell upon them here.

Some years ago, the most eminent astronomer and mathematician in Europe, and withal a capital chemist, long my kind patron and counsellor, asked me "Why I used that detestable chemical notation, and not the true algebraical?" I answered, that "I used it only to sum up or enunciate results obtained, and this in deference to the convention among chemists; but that I always *worked* with the algebraical." I take occasion to press this matter on the serious attention of chemists. They are using *two* signs for addition, or combination, or union— one, juxtaposition (the sign of multiplication), the other (+) the proper sign. They are using, also, the symbol of "powers" to express numerical multiples; but, worst of all, they too often use = where no numerical equality exists, to express "produce" or "result from." I have used above the simple sign of ratio (:); this is all-sufficient, as well as unequivocal, and, as it comprises equality in the form of $1 : 1$, is perfectly general, and I recommend it to chemists for adoption accordingly.

When I said that the equations—

$$A + B = C \quad \text{and} \quad \frac{A}{a} + \frac{B}{b} = \frac{C}{c}$$

could not co-exist unless—

$$c = \frac{A + B}{\dfrac{A}{a} + \dfrac{B}{b}},$$

I merely affirmed what is indisputably a general truth, whatever A, B, C, a, b, c, might be, so long as = signifies "numerically equal." But, of course, if = signifies "produces" or "results from," there is no more to be said, except that such an equivocal symbol should have no place in a science.

Let A be carbonic oxide, B oxygen, $a = 0.9706$, $b = 1.106$, then c should be $= 1.520$, if the equation between the volumes co-exist with that between the weights; but it comes out $= 1.016$. The volumes, therefore, cannot be equal, though the weights are equal. The explanation can only be that either the sign = has another signification, or the term volume has. Now, we know that, as $CO + O = CO_2$, the true ratio is—

$$1 \text{ mol. } CO + \tfrac{1}{2} \text{ mol. } O : 1 \text{ mol. } CO_2,$$

or—

$$2 \text{ vols. } CO + 1 \text{ vol. } O : 2 \text{ vols. } CO_2 ;$$

that is, as $3 : 2$, so that the above equality cannot exist. The numerical relation, then, between the weights, and that between the volumes, in this case are not identical.

I venture to suggest that it would be more fruitful of results, as well as more philosophical, to compare, in all cases, the sum of the volumes of the components with that of the compound (as we now compare their weights), placing (:), the sign of ratio, between them. If we are ever to express the specific gravity of a compound in a function of the specific gravities of its components, *all* of the latter must be included.

Mr. Routledge, in referring to the vapour of carbon, uses the term "imaginary gases." I only wish we were half as sure of the reality of "atoms" and "molecules," and knew as much about them and their mysterious agencies!

This "carbon vapour," it is assumed, cannot be exhibited in a separate state, though I would not venture to affirm that, with a high temperature *in vacuo*, this could not be done (the spectroscope would soon settle this point, if it has not already done so); but carbonic oxide, carbonic acid, cyanogen, and the two forms of carburetted hydrogen, are all homogeneous, transparent, elastic fluids, possessing all the mechanical and physical properties of the simple gases. Carbonic acid, like the vapour of water, can be condensed by cold and pressure into a fluid medium, and frozen afterwards into a solid. In the diamond, carbon is transparent, though infinitely hard and incompressible, while ice is sensibly elastic. Water is slightly compressible, and transmits a feeble sound, though composed of highly-elastic gases. The fair inference from analogy is, that carbon is capable of vaporisation, as are iodine, bromine, sulphur, mercury, &c. ; indeed, it is almost inconceivable that a gaseous body should have non-gaseous particles diffused among its mass, while the mass itself is homogeneous, as its action on light proves it to be. The densest of metals can be vapourised ; then why not carbon ?

Returning from this digression, which was scarcely avoidable, to the object of my original communication to your journal, I wish it to be understood that I did not profess to make any chemical discovery. I had conceived that, in the symbolical methods of chemists, there lurked either fallacy or ambiguity of signs, tending to mislead, and to lead to inaccurate conclusions. Whether I have been right in my impression, or how far my views of the matter are justified, I leave it to the candour of you and of your readers to decide.—I am, &c.,

F. C. Knowles.

Mayfield, near Ryde,
  Nov. 17, 1874.

FERROUS SULPHIDE IN CHAR.

To the Editor of the Chemical News.

Sir,—I have read with some interest the communications of Mr. Robert Frazer Smith "On the Presence of Ferrous Sulphide in Char," published in late numbers of the Chemical News, and also the criticisms they have evoked from Messrs. Speir and Stewart. It is somewhat refreshing to note the ardour with which many young chemists dilate upon some facts that come under their observations, and are deemed by them *discoveries*, or tantamount thereto. Bone char has of late been a happy source of such ambitious results in the hands of a few of the class indicated. I remember a critical analyst of the order furnished your readers some time ago with a *resume*, intending to prove that "char" always contained variable amounts of *organic matter*, amounting sometimes to 5 per cent. The current question of the existence of ferrous sulphide in char bears, I think, a close relation to the preceding alleged *discovery*.

Whilst I admire the zeal manifested by these men in *publishing* their results, I cannot help entertaining a slight dis-

approval of the language they use, whereby they depress the labours of other chemists to a lower level than that they fancy they have attained. Thus, Mr. Smith asserts—" All chemists usually state the total sulphur in char as calcic sulphate," a statement that is not generally correct, as I will show. I do not know how many other chemists besides myself recognised the fact; but, while engaged in writing the article, "Animal Charcoal," for the late Dr. Muspratt's "Chemistry, as Applied to the Arts and Manufactures," in 1852, I devoted considerable time to the examination of "chars," and then ascertained that all chars, *new* as well as old, contained sulphides. After numerous analyses, as critically exact as I could make them, I came to the conclusion that the sulphide in every instance existed as calcic sulphide. I have never found that the iron dissolved on treatment of the char with dilute HCl rose to the proportion necessary to constitute ferrous sulphide, with the H_2S eliminated; on the contrary, that the calcium exactly fitted the groove. Hence my conclusion to adopt calcic sulphide as the expression of the combination of the sulphur present as sulphide. From that time, whenever I have had occasion to make a complete analysis of "char," I have recorded this constituent among my results, deducing it from the determination of the H_2S evolved.

Unhappily, I cannot refer to particulars of those analyses, because the College Records containing them, and many others of my humble labours down to 1871, are in the hands of the executors of the late Dr. Muspratt, and I cannot get to refer to them; but, since the beginning of 1871, I can cite numerous examples in proof of the preceding statement. The following may be accepted as representative examples; they are copied from Record Book A, pp. 359 and 393, of the dates November 29 and December 28, 1871, respectively:—

ANALYSES OF CHARS.

	Date of Analyses, Nov. 29, 1871.		Date of Analyses, Dec. 28, 1871.		
	Sugar Char.	Treacle Char.	Char No. 1.	Char No. 2.	Char No. 3. Dust.
Carbon	8·841	8·960	10·363	10·814	12·161
Earthy phosphates..	78·872	84·920	80·091	82·275	78·128
Carbonate of lime ..	2·680	0·906	4·753	2·706	5·081
Sulphate of lime ..	0·281	0·180	0·304	0·273	0·331
Sulphide of calcium	0·773	1·134	0·468	0·383	0·352
Alkaline salts	0·291	0·241	0·149	0·183	0·169
Soluble iron oxide ..	0·206	0·528	0·462*	0·306	0·471
Insoluble matters, composed of silica and iron silicate ..	1·764	1·353	1·642†	1·527	1·505
Moisture	6·652	1·778	1·768	1·533	1·802
	100·000	100·000	100·000	100·000	100·000

* The marginal expression of these numbers is "oxide of iron soluble in strong mineral acids."

† Defined as "insoluble matters, consisting of sand and oxide of iron.

I could furnish you, Sir, with similar copies of analyses of chars made by me since the above dates, sufficient to fill several numbers of the CHEMICAL NEWS, were it necessary. In common fairness to Mr. Smith, and the expression already disapproved, I feel it incumbent on me to state that, in all the analyses of "chars" by other chemists which I have seen, I have not observed a single instance in which *sulphide* of any kind is tabulated among the constituents, excepting some modern ones by Dr. Wallace. Previous to 1873, however, he made no record of sulphide in his results—and I have seen several of his certificates—so far as I can ascertain at present.

I think (perhaps wrongly) I was indirectly concerned in determining the Doctor's attention to this component of "char;" for, towards the end of 1872, certain of my patrons here submitted some analyses of mine to the Greenock folk in the sugar trade, among whom Dr. Wallace commands a large practice. Whether my tabulation came under his eye or not, I cannot say; yet I cannot avoid regarding the coincidence as curious, that in all his results of chars made in 1873 he gives calcic sulphide as a constituent.

I point to these facts with the view of liberalising Messrs. Speir and Stewart's views, as rendered in CHEMICAL NEWS,

pp. 225 and 226. Respecting the extract from Dr. Wallace's letter given by Mr. Speir, I may remark that I made some elaborate analyses of chars for Messrs. Blair, Reid, and Steele, and furnished the firm with a lengthy "report" respecting them on the 26th of February, 1874; in these analyses, the amounts of calcic sulphide present were stated. It would be curious should my communication be withheld from Messrs. Smith and Speir, seeing they were chemists in the establishment at the time, and, doubtless, much interested in the solution of the enquiry then on foot.

However, Dr. Wallace certainly recorded calcic sulphide in char up to nearly the end of 1873; but since that time he may have educed reasons for changing his view.

I have seen no results of the Doctor's establishing the ferrous sulphide as the component, and I do not think Mr. Smith's experiments confirm its existence. When tangible proofs appear, I will be very ready to forego my long-entertained conclusions of the constitution of the sulphide; but, till these are produced, I am forced, by the circumstances already stated, to adhere to calcic sulphide. —I am, &c.,

MARTIN MURPHY.

The Liverpool College of Chemistry,
November 17, 1874.

DOUBTFUL MINERALS.

To the Editor of the Chemical News.

SIR,—My attention has been called to a long and good-humoured letter from a gentleman with the initials T. A. R., in the CHEMICAL NEWS of this day, and if I do not follow him into the details he invites me, it is certainly not from any desire to avoid touching pitch, or even T. A. R. himself, but because to defend the names assigned to the minerals in any collection or book is to defend a cause that is essentially a bad one.

Mr. Dana, in his last (1868) edition, has taken a great deal of trouble, and that in a thoroughly scholarly way, to arrive at the earliest names by which minerals were distinguished by their discoverers. And he has accordingly, in adopting these names, necessarily complicated the nomenclature of the science.

Responsible not only to Englishmen, but to the whole scientific world, for whom this collection is becoming a sort of Metropolitan collection, I have shrunk from the extensive changes in nomenclature that the adoption of Dana's names would involve.

I have changed a few names where ambiguity was associated with the old ones; otherwise I have adopted and held to such names as either my experience led me to think were associated in the minds of the greatest number of mineralogists with the particular minerals, or, in cases in which this might be doubtful, I have adopted names that either from their expressiveness, or from some other reason, appeared to me to be on the whole the best. The case of hemimorphite, for example, is one quite to the point, as I doubt not T. A. R. will see without words of mine. I don't suppose T. A. R. has really any difficulty in recognising the combination of zinc hydrate with zinc silicate under the name of herminorphite at least as well as under the names of smithsonite or of calamine. He has let his pen slip among these names in his letter, very naturally, considering the confusion that has attended their use. Here, as in the case of chalybite, I have made the smallest necessary change.

For *groups* like those of the felspars, the chlorites, and micas, I have retained for the present group names. Few mineralogists could be misled by this.

As regards T. A. R.'s requirement that this museum should contain every substance to which vanity or ignorance has given names, as well as those which have a place in scientific mineralogy, I only accept his judgment in respect to the latter class of minerals, and of these I trust he and others will find that wherever such rare minerals as are not here can be obtained, the museum will

be among the first in the field to obtain them. But it is to be remembered that several of them are not to be obtained at all.—I am, &c.,

NEVIL STORY MASKELYNE.

Mineral Department, British Museum,
Nov. 20th, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 16, October 19, 1874.

Dissociation of Hydrated Salts.—M. H. Debray.—The author complains that M. G. Wiedemann, in a recently published paper on the dissociation of the hydrated sulphates of the magnesium metals (*Poggendorff's Annalen*, jubelband, p. 474, 1874), has arrived at conclusions similar to his own, bearing date 1868, and has published them without any reference to the latter.

Magnetic Condensation in Soft Iron.—M. A. Lallemand.—The magnetic condensation first observed and studied by M. Jamin in steel, occurs also in soft iron with a very remarkable intensity and persistence. A horse-shoe electro-magnet is formed by a cylinder of iron, 4 centimetres in diameter, each limb of which is surrounded with a coil of wire of 2 m.m. in diameter, and 150 m.m. in length. The armature is a blade of soft iron 2 c.m. in thickness, and 4 in width. When the double coil is traversed by the current of a single Bunsen element, feebly charged, the keeper is able to support about 150 kilos. On interrupting the current the keeper remains strongly adhesive, a fact already often observed. It can support as much as 50 kilos. without detaching itself, but after this rupture every trace of magnetism disappears, and the electro-magnet is not even able to support the keeper. We might suppose that cohesion might be partly concerned in the adherence of the armature after the cessation of the current; but this is not the case, since no cohesion is manifested even under a greater pressure than that caused by magnetisation. Moreover, a magnetic needle placed in the vicinity of one of the polar surfaces shows a marked deviation, which disappears as soon as the keeper has been torn away. But what is particularly worthy of notice is the persistence of this magnetic condensation. An electro-magnet has been left for twenty days, and at the end of this time the keeper still supported 50 kilos. without becoming detached.

Hypothesis on the Imponderable Ether, and on the Origin of Matter.—M. Martha-Beker.—The ether is recognised and considered as a diffusive, subtile, imponderable substance, filling up not merely all the spaces of the universe, but all the insterstices, which isolate the atoms one from another, so that every impulse communicated to this subtile indefinite ocean is propagated amidst these infinitely small spaces, producing there the molecular motion which animates the depths of the constitution of matter, just as gravitation animates the depths of the sidereal world. The agitation communicated to the ether by the various luminous, thermic, electric, magnetic foci, secondary dynamic centres, transmits their rays by means of indefinite and successive currents of waves, and produces the fluids, properly so-called. Others seem to represent the dynamic manifestations which would emanate from a virtual focus, the centre of gravity, and of impulsion of the world, the prime motor of which would be distinct, conscious, and immaterial, as the universal harmony supposes and demonstrates. This virtual focus would impress upon the ether agitations variable in intensity and in direction, but obedient to the law of harmony, and of the final cause. These would be not merely parallel and successive waves, like those proceeding from the secondary foci, but series of waves of various powers, intersecting each other in points determined by the general plan of the universe. At the intersecting points of these waves will be formed veritable nodes, participating at once in the ethereal and in the dynamic nature, *i.e.*, atoms having an extension, or a real form, and a determinable atomic weight, the imponderable having been compressed so as to become ponderable. The nodes of waves of the same species, of the same amplitude or intensity, will engender like atoms; and as this will be most generally the case, there will result the most expanded, and the lightest simple element—hydrogen. If the two waves which cross each other have not the same amplitude and the same intensity, they will yield atoms of the same form as those of hydrogen, but they will not have the same weight, the same atomicity which will permit of substitution in their ulterior combinations without the structure of these combinations being altered. When, on the contrary, a node becomes the centre, if entanglement of more than two waves, there will arise atoms different in form and weight. The weights will increase in simple proportions, in relation to the number and the normal disposition of the waves which have concurred in the formation of the node. The first atom having been formed, and the movement continuing under the same conditions, there will ensue a successive accumulation of like atoms, which will group themselves into molecules floating in the ether, and which will gradually form the cosmic matter of the unresolvable nebulæ. The several groups of these formations will tend to concentrate themselves, and ultimately to coalesce into stellar agglomerations, there where the greatest mass of waves shall meet. These great concentric foci will arrange themselves in immense orbits, as the laws of astronomy reveal, carrying with them their train of secondary foci. Can matter thus formed annihilate itself again and disappear in the ethereal ocean, returning by inverse phases to its starting-point? To resume; by its various modes of vibration, indefinitely transmitted and susceptible of acquiring special properties, and a real palpable condition at the points where it concentrates itself in groups, the ether may not only give rise to imponderable fluids, but even to atoms themselves, and to the molecules of all the elements of ponderable matter.

Distribution of Sugar and of Mineral Principles in Beet-root.—M. Ch. Violette.—Contrary to the opinion hitherto received, the sacchariferous and cellular tissues of the beet-root contain proportions of sugar differing but little. The sugar increases very sensibly in an arithmetical progression, following the axis of the root from the neck to the point. The total mineral matters do not experience a regular variation, but chlorides are more abundant at the neck than at the extremity. The proportion of mineral matter is greater in the cellular than in the sacchariferous tissue, the relative amount of chlorides being three to eight times larger.

Experiments on the Circular Compass, made on Board the "Faon" and the "Savoie."—M. E. Duchemin.—The observers consider the circular compass preferable to the needle, both in fine weather and in storms. It has the advantage both in stability and sensibility.

Remarks on the Recent Papers of MM. Signoret and Lichtenstein on the Known Species of the Genus Phylloxera.—M. Balbiani.

Observations Relative to a Recent Note, by M. Rommier, "On Experiments made at Montpellier on Phylloxerised Vines with Coal-Tar."—M. Balbiani.

Influence of Temperature on the Development of the Phylloxera.—M. Maurice Girard.

Observations Respecting a Paper on Supersaturation by M. Lecoq de Boisbaudran.—M. D. Gernez.—M. Gernez defends his claims to originality, or rather to

novelty, which M. Lecoq de Boisbaudran had called in question.

Researches on the Decomposition of Certain Salts by Water.—M. A. Ditte.—The salt in question is the sulphate of mercury. In contact with water at common temperatures the sulphate of binoxide of mercury becomes instantly discoloured. Sub-sulphate is precipitated, and the water becomes strongly acid. The reaction continues on adding the neutral salt, until the amount of sulphuric acid set free reaches a certain limit. From that point the liquid decomposes no more of the salt, but simply dissolves the sulphate till it is saturated. The minimum quantity of free acid which a liquid must contain in order not to decompose the salt, increases as the temperature rises. Hence a clear solution of mercuric sulphate in water, containing 67 grms. of free acid per litre, becomes turbid when heated. The presence of another acid in the liquid does not affect the phenomena.

Absence of Iron in the Colouring Matter of Blood. MM. C. Paquelin and L. Jolly.—The authors have formerly shown that iron exists in the blood globule in the state of tribasic phosphate of protoxide, and that hæmatosin contains no iron. The second conclusion was formed from the fact that maceration of blood globules in ammoniacal alcohol, submitted to a series of filtrations and distillations, yields an impure hæmatosin, which becomes poorer in iron after every operation, and contains no longer a trace after the fourth treatment. Pure hæmatosin presents the following properties:—It burns, leaving no ash, like resinous bodies; it is insoluble in pure water; it dissolves sparingly in ammoniacal water, giving it a pale yellow colour. It is affected by caustic potash and soda, to which it gives a brown tinge; alcohol dissolves it sparingly, taking an amber colour. Its solvents are ether, chloroform, benzol, and sulphide of carbon. The dilute solutions are yellow, and the concentrated red. The authors announce their intention of giving the elementary composition of hæmatosin in a future paper.

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Annalen der Physik und Chemie, von Dr. J. C. Poggendorff, No. 5, 1874.

Mineralogical Communications.—G. vom Rath.—These communications consist of a contribution to our knowledge of the crystallisation and twin formations of tridymite; description of a remarkable crystal of calcareous spar from Lake Superior, *apropos* of which the author points out that a monograph of the modifications of calcareous spar would be a boon to mineralogists; a peculiar specimen of rutil and iron-glance grown together; remarkable crystals of artificial metallic copper; the discovery of hypersthene in a trachytic rock, *Rocher du Capucin,* near the baths of Mont Dore in Auvergne; and foresite, a new mineral of the zeolite family, from the granite veins of Elba. Foresite consists of—

Silica	49·96
Alumina	27·40
Lime	5·47
Magnesia	0·40
Potash	0·77
Soda	1·38
Water	15·07
	———
	100·45

It is most nearly connected with desmin.

Direct and Indirect Determination of the Poles of Magnets.—Th. Petruschevsky.—A long and illustrated paper, not adapted for abstraction.

Law of the Development and Grouping of Crystalline Zones.—Dr. G. Junghanns.—Not adapted for abstraction.

Resistance of the Air to Plane Discs, moved in a Normal Direction against their Planes.—G. Hagen.

Mechanical Principle proceeding from the Hamiltonian Theory of Motion.—J. J. Müller.

Previous Thermostats, and on a New Arrangement. H. Laspeyres.—The author points out the importance of being able to maintain for a length of time a perfectly constant temperature, and shows the disadvantages and imperfections of all apparatus hitherto devised for this purpose. His own thermostat is simple, trustworthy, and convenient. It permits of the maintenance for weeks—or so long as the required flame is kept up—of any given temperature between + 35° and 325°. For a bath he recommends sulphuric acid, which when undiluted boils at 325°, and by proper dilution with water gives every temperature down to 100°. For lower temperatures mixtures of absolute alcohol and water assist us down to 78·4°, and by mixtures of absolute alcohol and anhydrous ether we reach 34·9°. Any apparatus in which these four liquids or their mixtures can be boiled without change is a thermostat. It is essential, therefore, that all the vapour given off should be condensed and returned to the liquid. The apparatus may consist of glass. As the boiling vessel we may use a strait-sided Erlenmayer's flask, made of thin well annealed glass, and with as wide a neck as possible. It is closed above with a stopper of cork, or of caoutchouc, according to the temperature. As long as no acid vapours are given off cork is not attacked, if spirting can be avoided. In the stopper are two apertures about 5 m.m. in width for the condensation tube, and an opening as wide as possible to receive a test-tube, in which are placed the substances to be heated, along with a thermometer. The condensation-tubes are about 15 m.m. in width, and 20 to 25 c.m. in length. If the apparatus is required to be on a larger scale, it may be made of copper lined with sheet platinum, which must not fit too tightly.

Crystalline Form and the Modifications of Selenium. —C. Rammelsberg.—The author, differing from Mitscherlich, finds that sulphur and selenium are isomorphous, a view confirmed by the examination of the sulphide of selenium. Selenium appears in four modifications:—

1. Amorphous.	Sp. gr. 4·3		Red, soluble.
2. Crystalline.	„ 4·5		„ „
3. Granular.	„ 4·4—4·5		Grey, insoluble.
4. Foliaceous.	„ 4·8		Nearly black, insoluble.

At 90° C. Nos. 1 and 2 are converted into No. 3. By fusion and rapid cooling Nos. 2, 3, and 4 pass into 1, but by slow cooling into 3. All the modifications are permanent. As the granular and foliaceous forms of selenium are evidently crystalline, it must be regarded as tri-morphous. None of the modifications of sulphur assume, like the grey form of selenium, the physical characters of a metal, *i.e.,* the power of conducting heat and electricity.

Transformation of the Vibroscope into a Tonometer, and on its Use to Determine the Absolute Number of Vibrations.—A. Terquem.

Simple Apparatus for the Production of Ozone by means of Electricity of High Tension.—Prof. A. W. Wright.—Extracted from the *Am. Journ. Sci.,* series III., vol. iv., p. 26.

Spectroscope with a Fluorescent Eye-piece.—J. L. Soret. —(*Arch. des Sciences Physique,* April, 1874.) Two methods have been applied for observing the ultra-violet portion of the spectrum. In the one it is photographed. The prepared plate is introduced in an ordinary spectroscope, there where the thread-cross of the telescope is in general to be found. An extremely delicate image of the spectrum is thus obtained, and, with some experience, it is possible to measure the deviation of the lines accurately. But, upon the whole, the operation must be pronounced tedious and complicated. In the second method the spectrum is thrown upon a fluorescent substance, when the ultra-violet portion becomes visible. But the observation must be made in a totally dark room, and is ill adapted for the measurement of angles. The procedure here recommended, a modification of the second method, consists in placing a plate of some transparent and fluorescent substance in the telescope of the spectroscope at the focus of the object-glass, and in examining the

spectrum with an eye-piece inclined towards the axis of the telescope. We pass over the detailed description of the apparatus, as unintelligible without an illustration, and proceed to the author's account of his experiments. With uraniferous glass the fluorescent spectrum is very visible from the line G. It is very intense towards H; the four stripes, M, are also visible, but beyond it is less distinct. With bisulphate of quinine the spectrum is very beautiful and brighter. It extends but little into the visible portion, about to *h*. The lines are very distinct as far as the group N, and even a little beyond. Æsculin, slightly concentrated, seemed to give the most intense spectrum. The line N, and even O, can be clearly distinguished. The spectrum extends into the violet, somewhat farther than quinine. Magdala red (naphthalin) somewhat concentrated, gives inferior results for the ultra-violet portion beyond M. The appearance of the fluorescent spectrum in the part corresponding to the directly visible rays is peculiar. Almost from D to M all lines are perfectly distinct. The appearance presented depends not alone on the fluorescent substance and its degree of concentration, but also on other circumstances. The intensity of the sunlight has a great influence. If the sky is not clear, or the sun near setting, the spectrum loses much of its intensity. The nature of the prism is also important. With one, and even with two prisms of white flint glass there is seen a great extent of the ultra-violet spectrum, especially when the bundle of rays passes close to the edge of the prism. Heavy flint glass, as is well known, absorbs the ultra-violet rays. The same occurs with the system of prisms in direct-vision spectroscopes. A more extended spectrum could doubtless be obtained with prisms and lenses of quartz or of calc-spar. As regards the application of this procedure to the study of the ultra-violet spectra of metals, the results obtained have not been quite satisfactory.

Conversion of Ordinary Phosphorus into the Amorphous State by the Action of Electricity.—Professor v. Schrötter.—In these experiments Dr. Geissler uses an exhausted glass tube 35 centimetres long, 2 centimetres wide, into the ends of which the conducting wires are fused in additional pieces, so that their extremities are at least 45 centimetres apart from each other. The tube was filled with phosphorus-vapour of low tension. After the experiment the sides of the tube were lined with a thin layer of amorphous phosphorus, varying in colour from reddish brown to a golden yellow.

Spectra of Lightning.—Th. Hoh.—During a thunderstorm at Bamberg, April 23, the author observed the spectra of several flashes. He counted two or three lines in the red; one each in the yellow and orange; three to four in the green; and one in the violet. On occasion of a very brilliant flash he distinguished a group of five lines in the blue.

NOTES AND QUERIES.

Alumina.—Can any of your correspondents tell me the best precipitant for alumina from an acid solution, on a large scale? Also the best method of filtering?—ALUMINA.

Estimation of Organic Bodies.—Could any of your numerous readers inform me of any book containing articles on the quantitative estimation of the following substances:—Aniline, anthracen, mineral oils, sugar, and charcoal?—R. S.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of sulphate of soda and sulphate of potash, and in apparatus used in the said manufacture. William Hunt, manufacturing chemist, Castleford, near Normanton, York. March 6, 1874.—No. 831. This invention refers to the manufacture of sulphate of soda and sulphate of potash by the action on chloride of sodium and chloride of potassium of a mixture of sulphurous acid gas, steam, and atmospheric air. According to this invention the gaseous mixture or current is passed through the chambers containing the chloride in an alternately upward and downward direction; that is, the current passes downwards in the first chamber, upwards in the second

chamber, downwards in the third chamber, and so on; and after a time the current is reversed, ascending in the chambers in which it had previously descended, and descending in the chambers in which it had previously ascended. The apparatus for conducting the manufacture consists of a series of chambers arranged in a circle, with a conical tower in the centre. The heat given out by the decomposition of the chloride in the chambers is sufficient to produce the required draught through the apparatus without the use of a steam-jet. From the top of the conical tower the gaseous current passes to the condenser

Improvements in the means of preserving animal and vegetable substances. Gabor Naphegyi, merchant, London Wall, London. March 6, 1874.—No. 834. Ethyl and methyl are introduced into a close receptacle containing the substance to be preserved.

Improvements in the means or method of purifying foul water or sewage, and in the apparatus employed in connection therewith. Rupert Goodall, machinery agent, Armley, near Leeds, York. March 7, 1874.—No. 848. This invention has for its object the construction of apparatus to be employed during the process of purification of foul water and sewage, and in the combination of ingredients to be employed.

Improvements in utilising a certain waste or residual product obtained in the manufacture of aniline dyes. George James Hind, Wolverhampton, Stafford. March 11, 1874.—No. 878. This invention consist in revivifying or restoring to its original condition the finely-divided metallic iron which has been oxidised in the manufacture of aniline dyes, and which is ordinarily a waste or residual product, so that the said finely-divided metallic iron can be used over and over again in the manufacture of aniline dyes, or for other purposes where finely-divided iron is required. To effect this object the waste or residual product referred to is heated to a red-heat in admixture with charcoal or other carbonaceous matter so as to reduce the oxide of iron to the metallic state. After the mixture has cooled the metallic iron is separated from the unconsumed carbon by screening or sieving. Or instead of solid carbon, carbonic oxide, or hydrogen, or coal gas in conjunction with heat, may be employed for revivifying the iron.

MEETINGS FOR THE WEEK.

MONDAY, Nov. 30th.—Royal (Anniversary Meeting).
—— Medical, 8.
TUESDAY, Dec. 1st.—Civil Engineers, 8.
—— Zoological, 8.30.
WEDNESDAY, 2nd.—Society of Arts, 8. "On the Expediency of Protection for Inventions," by F. J. Bramwell, F.R.S
—— Geological, 8.
—— Microscopical, 8.
—— Pharmaceutical, 8.
THURSDAY, 3rd.—Chemical, 8. "On the Colour of Cupric Chloride, by W. N. Hartley; "On the Formulæ of the Alums," by Sydney Lupton.
FRIDAY, 4th.—Geologists' Association, 8.

TO CORRESPONDENTS.

G. C. S.—Your communication contains no facts of interest to any of our readers, and we cannot occupy valuable space with a merely personal discussion.

THE CHEMICAL NEWS.

VOL. XXX. No. 784.

ON THE BITUMINOUS DEPOSITS OF THE VALLEY OF THE PESCARA. SOUTH ITALY.

By Dr. R. CARTER MOFFAT, Professor of Chemistry, Glasgow: Italian Gold Medallist for Industrial Investigations and Discoveries.

THE vast deposits of bituminous limestone situated in the valley of the Pescara are of great commercial, value and can be easily and cheaply worked. The district is little known, but in a few years I believe several companies will be at active work in excavating the ore and extracting the bitumen. I spent five weeks inspecting the district professionally last spring, and carried out experiments to ascertain the commercial value of the minerals, and the best modes of extracting the bitumen, and also the manufacture of oil direct from them.

The bituminous rocks of Rocca Morici, San Giorgio, Aqua Fredda, Santa Maria, Fava San Martino, Santa Liberata, Fonticelli, Chiuse, Arrenario, Fondocello, Crocifisso, and Romana are all in the Province of Chieti, and for most part are found in the valley of the Pescara. A railway runs in the valley within a few miles of the deposits connecting with important lines and ports.

Labour is abundant at less than 9d. per day, while wood and peat for fuel are to be had at about 8s. per ton for wood, and 5s. for peat delivered at most of the mines as the deposits are termed.

The limestone with which the bitumen is impregnated varies in character and composition in several of the mines. While the mineral is always calcareous it is in the generality of places magnesian limestone, but in a few of them it is gypsum and selenite.

The amount of bitumen in the ores varies from a few per cents to 50, and it becomes a matter of great importance in selecting a mine (which is to be had for a merely nominal sum) to pay special attention to the experimental determination of the amount of bitumen as derived from a great many trials. Much experience is required to know by sight a very good from a very moderate sample. I have seen many samples apparently very rich in bitumen yield but little when tried.

The best mode of extracting it is by "Bennie's patent retort for manufacturing refined bitumen," which allows of a continuous and uninterrupted working.

Messrs. G. Bennie and Co., Kinning Park Foundry, Glasgow, are well-known and extensive manufacturers of oil-work plant, and indeed make it a speciality, and do little else. The senior partner, Mr. G. Bennie, has frequently visited the bituminous deposits, and has, after minutely studying the matter, devised and patented this apparatus in Italy, which certainly supersedes all other kinds at present used from its simplicity, cheapness, effective and continuous working.

The bitumen so produced is practically pure, and can be sold at present in London for £6 per ton, while it costs only £1 2s. 6d. per ton to produce it at the mine. One ton of mineral can be raised at the rate of 1s. 6d.

When the bitumen is distilled 1 ton yields 100 gallons of oil of sp. gr. 955, giving 25 per cent burning oil of excellent quality and 62 per cent heavy lubricating oil of 950 gravity.

Crude oil is sold in Italy at 8d. per gallon, and burning oil is readily bought up wholesale at 2s. per gallon.

There is a very high rate of import duty on burning oil in Italy, 10d. per gallon being levied on all burning oil imported. Consequently this oil commands more than double the price that it does in this country.

To capitalists the working of these deposits for bitumen and oil hold out, under judicious and intelligent management, the surest prospect of excellent and highly profitable investment.

In my opinion it cannot be long before the great mineral wealth of the district is being turned to good account.

ON ERRORS OF WEIGHING, AND THEIR INFLUENCE ON RESULTS.*

By H. R. PROCTER.

IN the following paper I cannot pretend to lay before the Chemical Society any new or original results, but have merely attempted to notice in a concise form the most important errors of weighing, and to give short details of the methods of correction, since, clearly as the principles involved are explained in most text-books, I have, for my own part, found their actual application rather puzzling.

I think it is only fair to myself to say that I had not seen the chapter on the subject in Professor Thorpe's text-book until my paper was in print, and it was too late to re-model it, or I should certainly have avoided going over so much of the same ground. As it is, I am encouraged to let it stand, since the methods I have given are not exactly the same as his; and since I find that, even in the last German edition of Fresenius, no notice is taken of the method of weighing by vibrations, and no detailed rules are given for the correction of weights.

In weighing, as in all other kinds of accurate measurements, the result is vitiated by errors of two kinds; first, those arising from inexact observation and incidental causes, and which are variable in each weighing. These we may call "*errors of observation.*" Secondly, we shall have errors arising from faults in the balance, unequal length of its arms, inaccuracy in the weights, and defects in the mode of weighing, which will occur constantly in all weighing, and which may be called "*instrumental errors.*" Errors of observation may be almost got rid of by taking the average of a large number of experiments; for though each observation will be more or less in error, it will happen that some of the values will be greater, and some less than the truth, and the errors will counteract and destroy each other's influence on the mean result. This, it is obvious, will not be the case with the instrumental errors, for it will generally happen that these will occur constantly on the same side, and so cannot correct each other, but will remain uneliminated in the final average result. Before examining the special corrections which are necessary to remove these, we will consider a little more closely the variable or observation errors.

We have said that the most probable value is obtained by adding all the results of a series of experiments together, and dividing the sum by the number of observations. This mean value will probably differ more or less from each of the individual results. From these differences we may calculate the accuracy of our experiments. If we square each of these differences, add them together, divide them by the number of observations less one, and take the square root of the quotient, we obtain the *mean error of a single observation*, and dividing this by the square root of the number of observations, we obtain the *mean*, or average *error of the final result*. The "*probable errors*" in each case are about $\frac{1}{3}$ less than the *mean errors*, and are obtained by multiplying the latter by $\frac{2}{3}$, or more accurately by 0·6745. The "probable error" is equally likely to be greater or less than the actual, but unknown, error. Without here considering the rather intricate reasoning which has led to these rules, we may employ them to estimate the scientific value of our determinations.

In the ordinary method of weighing, in which weights are put on until the pointer swings to equal distances on each side of the zero, there are several sources of inaccu-

* A Paper read before the Newcastle-upon-Tyne Chemical Society.

racy of observation, even supposing the balance were perfect. In the first place, it is not possible *exactly* to hit the right weight in any finite number of trials, although we may come as near it as we please. Secondly, as the swing of the balance gradually diminishes, it is difficult to tell when the exact zero is obtained.

A much better method, more rapid, as well as more accurate, is as follows:—After adding weights in the ordinary way, till we are, say, less than a milligramme below the weights required, we note the limits of an uneven number, say five, consecutive swings of the balance. Finding the average limit of swing on each side, and again taking the average of these two, we obtain the position in which the index would settle if the balance were at rest. This will be at some little distance to one side of the zero of the unloaded balance. Adding now 1 milligramme to the weights, another position of rest may be observed. Then, by rule of three, as the distance of the first point from the zero of the unloaded balance is to its distance from the point with 1 milligramme added, so is the fraction of the milligramme required to the whole milligramme put on. A numerical example will make this clearer. To avoid *minus* quantities, we reckon the scale of the balance from the side on which the weight scale is hung, so that the centre of the scale will count 10 instead of 0, and additional weights will give greater readings. Fractional parts of divisions are estimated, which is very easy if the balance swings only once in 15 or 20 seconds. Suppose our successive turning-points are, with the weight, w, on the scale—

			Means.	Position of rest.
Right ..	7·5	7 6	7·8 7·63	9·49
Left ..	11·4	11·3	11·35	

and that we have similarly obtained 10·34 as the position of rest of the unloaded balance, and 11·29 with $w + 1$m.grm.; subtracting 9·49 from these, we obtain the differences 0·85 and 1·80, and our required weight will be $w + \frac{85}{180}$ m.grm, or $w + 0·47$ m.grm. Though this method looks rather complicated, it is really done very quickly, since there are no useless trials, as in the ordinary way; but the labour may be still further lessened by the construction of a table of deflections of the balance for 1 m.grm., with different loads. Then, for any observed deflection from zero, the corresponding weight may be at once taken from the table. As specimen of such a table, I give one constructed for my own balance at the end of the paper. Such tables must be verified occasionally, as the sensitiveness of a balance is liable to slight variations. It is also necessary frequently to determine the zero-point when heavy loads are used, whatever mode of weighing be adopted.

So far, we have assumed that, when the pointer was at the zero of the unloaded balance, the two loads were truly of equal weight; but, in order that this may be the case, the two arms of the balance must be of exactly equal length, a condition which is never rigorously fulfilled. Indeed, it is possible that it should, since an error of only 1-10,000th of an inch in a balance with 14-inch beam would cause an error of nearly 1½ m.grms. with a load of 100 grms. For chemical purposes, where only relative weights are required, this may be neglected if the weights are always placed on the same scale. Where absolute weighing is necessary, as, for instance, in testing a set of weights, we must eliminate the error. I need scarcely advert to the methods of doing this by substitution and double weighing. In the first case, the weights are tared, and the substance to be weighed is then placed on the same scale, and weights removed till a balance is again obtained. In the second, the substance is weighed first on one scale and then on the other, and the mean of the two results is taken, and the errors, being equal and in opposite directions, will balance and destroy each other. Another way is once for all to determine the ratio of the arms, and then the true weight is obtained from any observed weight by multiplying by this ratio; or, still better, a table may be constructed giving the calculated correcting for different loads. As the ratio is very small, it is best found by observing the deflection in the following manner:—The zero of the balance when oscillating unloaded is observed; then two approximately equal large weights are put on—say, 50 grms. on each scale—and the zero observed again. The weights are changed to the opposite scales, to eliminate any small inaccuracy in their equality; and the process is repeated, finishing by observing the zero of the unloaded balance a second time. Then the means of the two loaded and unloaded zeros are taken, and the difference between these reduced to m.grms., as described before, is the correction to be added or subtracted for the load employed; and the ratio of the two loads so corrected is the same as that of the *opposite* balance arms. I need scarcely say that the addition must be made to the load *towards* which the pointer is deflected, or the *subtraction* from the *opposite* side. Having found the correction for any load, that for any other may be found by rule-of-three. Thus, if that for 100 grms. is 3 m.grms., that for 50 will be 1·5 m.grms. In my own balance, a very good one by August Sauter, of Ebingen, it amounts to about 2 m.grms. per 100 grms., and consequently the ratio of the arms is as 1 to 1·00002. As the correction is small, it is never necessary to apply it to the smaller weights, and, indeed, a table of values for every 5 or 10 grms. would generally be sufficient.

Another, and still more important, source of instrumental error is the inexactness of the weights; and no ordinary set, even of the best makers, is really accurate. It is, therefore, always necessary to examine them and make a table of corrections. The simplest way of doing this is to assume, provisionally, that the smallest weight, say, the c.gr., is accurate, and then to determine all the rest in terms of it, preferably by double weighing. Of course, weights of the same name must be distinguished by marks of some kind—dots made with a centre-punch are as good as any. It will be easy to weigh one c.gr. against the other, and then with these to weigh the 2 c.gr., and so on. Suppose the second c.gr. is found (by deflection or the use of the rider) to weigh, say, 10·01 m.grms., the two together must be called 20·01 m.grms., and the error may go on accumulating till, with the largest weights, it amounts even to grms.; but this is of no consequence. If we have no normal weight with which to compare our set, it is generally best to assume the sum of the large weights as correct. Suppose, now, that they weigh 103·754 grms. in terms of the 1 c.gr. weight, instead of 100 grms., the true amount, we must divide all our observed weights by 1·03754 (or multiply by its reciprocal) in order to obtain a series of numbers which shall actually represent the relative values of our weights, and which will add up to exactly 100 grms. That they do this is a proof of the correctness of the numerical work. If we always use the weights in the same order, it will now be easy to make a table showing the whole correction to be added to any observed weight. It will be seen that in some cases it amounts to almost half a milligramme, quite an important error in an organic analysis.

A source of error almost universally neglected, is that caused by the weighing being conducted in air instead of *in vacuo*. To illustrate the principle by an extreme case, we know that, while a cork weighed in water would weigh less than nothing, a lead bullet would lose comparatively very little. In a less degree, the air has exactly the same effect as the water, and in weighing bodies of low specific gravity with dense weights, such as brass or platinum, the loss may amount to something considerable. For instance, in weighing 100 c.c. of water with brass weights it would amount to 10·6 m.grms. If absolute accuracy were required, it would be necessary also to take account of the changes of density of the air as shown by temperature and barometric pressure, but for chemical purposes this could scarcely be important, except in determination of vapour densities. I therefore content myself with giving at the end of the paper a table for correcting weighings with brass weights at ordinary temperatures, and refer for fur-

ther information to special articles on such determinations. To show the importance of at least a rough correction, even in ordinary chemical work, Professor Kohlrausch points out that, in the common case of determination of Ag as AgCl in a weighed quantity of a dilute solution, the correction may influence the result as much as $\frac{1}{10}$th per cent.

In conclusion, I must say a few words on the influence of errors on results. It is but rarely that we can directly weigh the substance we are estimating, but in most cases we have to weigh some compound, and multiply the observed weight by a factor, to reduce it to that of the substance required. The errors will obviously be multiplied at the same time, and hence, other things being equal, the smaller the factor, or in other words, the larger the atomic weight of the compound weighed, the less influence errors will have on the result. Thus, in an organic analysis, an error in weighing the substance at first goes directly into the result, while 1 m.grm. error in the weight of the potash bulbs will only make $\frac{3}{11}$ m.grm., and in the calcic chloride tube $\frac{1}{9}$ m.grm., difference in the result. We should always, at least in scientific work, make a rough estimate, at any rate, of the probable influence of the various corrections, and only neglect them when we find their amount small compared to the probable error from other sources. This will frequently be the case, but not always, and the information as to the amount of accuracy we may expect from our results is often very important; as, for instance, in fitting an empirical formula to an analysis. Let us take the common case of sulphur determination as baric sulphate, say, in a pyrites containing 50 per cent. Supposing I use 1 grm. of the substance, the probable error of weighing with my balance (as estimated from the differences in a series of ten weighings of the same mass) will be about 0·1 m.grm., or only 0·01 per cent, the correction for inequality of balance arms, and the reduction to *vacuo* practically *nil*, as baric sulphate and pyrites are both weighed on the same scale, and are nearly of the same density; while the error of weights may amount to nearly 0·05 per cent. Here we see that, while all the other corrections may be disregarded, it would be quite inadmissible scientifically, whatever it might be commercially, to carry the percentage result to two places of decimals while neglecting the error of the weights. To sum up, the inequality of balance-arms may be neglected in all ordinary chemical work, the reduction to *vacuo* is only necessary when the substance has to be weighed in two forms of very different density, but the weights must always be corrected, and the zero-point of the unloaded balance constantly observed, since its variation is one of the principal sources of observation error. It is well to estimate the probable amount of the latter, by occasionally doing a series of weighings of the same mass, and observing the unloaded zero-point each time; and, whenever we have a series of analyses of the same substance, we should calculate the probable error of the final results by the rules given above. If this were done, it would, I venture to think, be found that only in very rare cases it is scientifically allowable to carry percentage results to two places of decimals, since even the errors of weighing alone, with excellent instruments and great care, will seriously falsify the last figure.

DEFLECTION OF BALANCE CORRESPONDING TO

With load of	0·1 m.grm.	0·2 m.grm.	0·3 m.grm.	0·4 m.grm.	0·5 m.grm.	0·6 m.grm.	0·7 m.grm.	0·8 m.grm.	0·9 m.grm.	1·0 m.grm.
0 grm.	0·26	0·51	0·77	1·02	1·28	1·53	1·79	2·04	2·30	2·55 div.
10 ,,	0·24	0·48	0·72	0·96	1·20	1·44	1·68	1·92	2·16	2·40 ,,
20 ,,	0·19	0·38	0·56	0·75	0·94	1·13	1·32	1·50	1·69	1·88 ,,
30 ,,	0·19	0·38	0·56	0·75	0·94	1·13	1·32	1·50	1·69	1·88 ,,
40 ,,	0·19	0·38	0·57	0·76	0·95	1·14	1·33	1·52	1·71	1·90 ,,
50 ,,	0·17	0·34	0·50	0·67	0·84	1·01	1·18	1·34	1·51	1·68 ,,
60 ,,	0·16	0·33	0·49	0·66	0·82	0·98	1·15	1·31	1·48	1·64 ,,
70 ,,	0·16	0·32	0·47	0·63	0·79	0·95	1·11	1·26	1·42	1·58 ,,
80 ,,	0·16	0·32	0·47	0·63	0·79	0·95	1·11	1·26	1·42	1·58 ,,
90 ,,	0·13	0·26	0·40	0·53	0·66	0·79	0·92	1·06	1·19	1·32 ,,
100 ,,	0·13	0·26	0·38	0·50	0·63	0·75	0·88	1·00	1·13	1·25 ,,

REDUCTION OF A WEIGHING WITH BRASS WEIGHTS TO WEIGHT IN VACUO.

Δ.	K.	Δ.	K.
0·7	+1·57	2·0	+0·46
0·8	+1·36	3·0	+0·26
0·9	+1·19	4·0	+0·16
1·0	+1·06	5·0	+0·10
1·1	+0·95	6·0	+0·06
1·2	+0·86	7·0	+0·03
1·3	+0·78	8·0	+0·01
1·4	+0·71	9·0	−0·01
1·5	+0·66	10·0	−0·02
1·6	+0·61	12·0	−0·04
1·7	+0·56	14·0	−0·06
1·8	+0·52	16·0	−0·07
1·9	+0·49	18·0	−0·08
2·0	+0·46	20·0	−0·08

$$\frac{k}{1000} = 0 \cdot 0012 \left\{ \frac{1}{\Delta} - \frac{1}{8 \cdot 4} \right\}.$$

If the weighed body has the density Δ, and its weight in air be m grms., mk m.grm. must be added to reduce the weighing to *vacuo*.

ON A COLORIMETRIC METHOD OF DETERMINING IRON IN WATERS.*

By THOMAS CARNELLEY, B.Sc.

Of late years the analysis of water has become of such importance that any improvement in the methods employed in that analysis will, it is thought, be acceptable, however small such improvement may be; and it is with this consideration that the following paper is submitted to the Society.

In the determination of heavy metals in water, with the exception of lead, great inconvenience arises from the want of rapid and accurate methods of estimating very small quantities, and it is to remedy this inconvenience in the case of iron that the following method is proposed:— Besides accuracy, it fulfils both the other requisites, viz., rapidity and the power of determining exceedingly small quantities; for without any evaporation 1 part of iron in 13,000,000 parts of water can be detected and a determination made in less than fifteen minutes; the smallest amount of ammonia which can be detected by the well-known Nessler test, without contraction, being only 1 part of ammonia in 20,000,000 parts of water; and moreover, as water will admit of evaporation without loss of any iron it may contain, the iron which can be estimated may be reduced to almost an infinitely small quantity.

The method consists in the comparison of the blue colours produced by adding to a solution of potassium ferrocyanide, first, a solution of iron of known strength, and, secondly, the water in which the iron is to be determined.

The standard solutions and materials required are as follows:—

(1.) *Standard Iron Solution.*—This is prepared by weighing out 0·7 grm. of ammonio-ferrous sulphate (=0·1 grm. Fe), dissolving the water, and adding 1 c.c. of the sulphuric acid; the iron is next oxidised by adding an exact sufficiency of the potassium permanganate solution from a burette, and the whole diluted to 1 litre. Of this solution 1 c.c. = 0·0001 grm. Fe.

(2.) *Solution of Potassium Permanganate.*—This must be moderately dilute, but it is not necessary that it should be of standard strength.

(3.) *Standard Nitric Acid*—is prepared by diluting 50 c.c. of pure strong nitric acid to 1 litre.

(4.) *Potassium Ferrocyanide Solution*—is obtained by dissolving 1 part of the salt in 25 parts of water.

(5.) *Strong Sulphuric Acid*—diluted with an equal volume of water.

(6.) *Two similar Glass Cylinders and a Glass Rod.*— The former should hold rather more than 200 c.c. each, the point equivalent to that measure being marked on the glass.

* A paper read before the Manchester Literary and Philosophical Society.

(7.) *A Burette*—marked to $\frac{1}{10}$ c.c. for the iron solution, and an ordinary burette for the permanganate.

(8.) *Three* 1 *c.c. Pipettes*—for the ferrocyanide, nitric acid, and sulphuric acid respectively, the one for the last being marked also to deliver $\frac{1}{2}$ c.c.

The following is the method of analysis employed :— A measured quantity of the water, less than 1 litre in bulk, is taken, the amount being regulated according to the quantity of iron contained in the water, which is judged by a previously made qualitative experiment, of adding 1 c.c. of the ferrocyanide to a portion of the oxidised water : 1 c.c. of the sulphuric acid is added, and then the permanganate from a burette, till a permanent faint pink colour is obtained; the whole is made up to 1 litre, when it forms what may be called the "water-test solution." Into each of the cylinders 1 c.c. of the potassium ferrocyanide is added, and then a measured quantity of the water-test solution put into one of them (x); both are next filled with water up to the mark, and 1 c.c. of the standard nitric acid added to each. After (x) has been well stirred, the standard iron solution is gradually run into (y), the liquid being stirred after each addition, and the colours in the two cylinders compared by placing them side by side over a sheet of white paper in front of a window: this is repeated till the colours in each of the cylinders appear to be equal, which point completes the operation.

Every cubic centimetre of iron solution used corresponds to 0·1 m.grm. of iron, from which the amount of iron added to cylinder (y) can be calculated. Then, assuming that equal shades of colour are, *ceteris paribus*, produced by equal weights of iron, the amount of the latter in cylinder (x) is equal to that added to (y), and since the volume of the original sample of water in the test solution is known, and also the volume of the latter put into (x), the amount of iron in a measured quantity of water can therefore be calculated. The volume of the test solution put into cylinder (x) should be such as not to require more than 5 c.c. of the iron solution to be added to (y) to produce an equal shade, for if more be added the colour obtained would be too dark to compare with ease and accuracy.

If the sample of water contains such a small amount of iron as, after oxidation, not to give a colouration directly with the ferrocyanide and nitric acid, a sufficient quantity of it must be evaporated with $\frac{1}{2}$ a cubic centimetre of the sulphuric acid till it occupies from 100 to 200 c.c. The liquid is then poured into a flask, together with the rinsings, and oxidised with permanganate to a very slight excess, and then filtered so as to separate any precipitate, and also to destroy the excess of permanganate. The fluid thus obtained is next tested as before, by adding the whole or a known part of it to one of the cylinders containing the ferrocyanide. When the water, after being filtered, has still a cloudy appearance, as is the case with sewage and polluted rivers, &c., a known quantity of the filtered water must be evaporated to dryness and ignited, the residue dissolved in a small quantity of hydrochloric acid, and filtered, washed with water, and the free acid in the filtrate as nearly as possible neutralised with ammonia and then 1 c.c. of sulphuric acid, after which oxidised with permanganate, then filtered—if requisite—to destroy excess of permanganate, and the iron estimated as before. A green colour may be sometimes obtained instead of the pure blue : this is owing to a slight quantity of unreduced permanganate being present : this, however, is of no consequence, as with a little practice the green tint may be compared with the blue, and correct results obtained ; still the comparison may be rendered easier by adding one to two drops of permanganate to the cylinder to which the standard iron is run, and which by this means will also assume a green tint. Experiments were made with reference to this point, and it was found that the presence of not more than a few drops of unreduced permanganate has little or no effect on the results obtained, the only consequence being the change of tint, but not of depth of colour.

Potassium permanganate is employed as the oxidiser instead of the nitric acid, because—(1.) The oxidation is performed much quicker than it would be if nitric acid were used, and in the latter case the liquid would have to be heated. (2.) It can be added to exactly the right point, which could not easily be done with nitric acid. (3.) An excess of the latter is very detrimental to the accuracy of the method, for, from experiments made in relation to this point, it was found that when the amount of free acid present in 200 c.c. was more than 0·0025 c.c. of the strong acid, it renders the colour deeper than it otherwise would be.

One cubic centimetre of the standard nitric acid is added to each of the cylinders, because—(1.) It renders the reaction much more delicate. (2.) Because the colours produced in the presence of this amount of free acid are almost always of the same tint, being of a pure blue, whilst when no free acid is present the colour varies—even when apparently of the same depth—from a blue to a bluish-green, which renders them less easy to compare. (3.) Because it destroys the effect which the presence of a small quantity of any free acid, previously existing in the liquid, might have in altering the shade of colour produced; for from a series of experiments made with reference to this point also, it was found that when the amount of free acid present, in addition to the 1 c.c. of standard nitric acid added, is only small,—*i.e.*, less than 0·05 c.c. of the strong acid in 200 c.c. of water,—it has no effect on the depth of colour produced. When any free acid exists in the water to be examined, it must, before being oxidised, be made as nearly neutral as possible with ammonia, and the iron then determined.

The following are some of the results obtained on determining the iron in solutions of known strength :—

Iron Found. Milligrammes.	Iron Calculated. Milligrammes.
17·990	19·480
4·200	4·140
1·800	1·860
0·610 with salts (C) present	0·570
0·510	0·520
0·400	0·410
0·400 with KNO$_3$ (D) present ..	0·400
0·330	0·300
0·280	0·310
0·230 with salts (B) present	0·220
0·200	0·210
0·140	0·160
0·120	0·100
0·070	0·078
0·025	0·031

In order also to test the effect which the presence of different salts has on this method, four series of experiments were made by adding known weights of the following salts to 1 litre of the ammonio-ferrous sulphate solution :—

(A.) Calcium sulphate, magnesium sulphate, ammonium chloride, sodium chloride, and potassium carbonate, in all 1·6 grm.

(B.) Ditto, in all 0·9 grm.

(C.) Magnesium sulphate, ammonium chloride, potassium carbonate, sodium chloride, and calcium chloride, in all 0·8 grm.

(D.) Potassium nitrate, 0·4 grm.

The solutions thus obtained were oxidised with permanganate and sulphuric acid diluted to 1 litre, and the iron estimated as previously described. The results obtained are given below, the letters attached denoting to which of the preceding series they severally belong, and from them it will be seen that the presence of these salts has little or no effect.

It was also found that neutral organic matter is not detrimental to the method.

With reference to the delicacy of the method it was found, as a mean of seven experiments, that 0·0055 m.grm. of iron gives a very distinct colour on the surface, and that

0·015 m.grm. gives a blue colour on being stirred with 200 c.c. of water, and therefore that 1 part of iron produces a blue colouration in 13,000,000 parts of water containing ferrocyanide of potassium and nitric acid. According to Hartig,* however, 1 part of iron (in the form of sulphate) only produces a colour in 600,000 parts of water containing ferrocyanide. The difference of these results is due to the effect which the presence of the small quantity of free nitric acid, added in the new method, has in increasing the delicacy of the reaction.

As to the smallest differences of reading which can be detected, it was found that when any quantity of iron solution below 1 c.c. had been added, a difference of 0·05 c.c. can be discriminated; above 1 and below 2 c.c., a difference of 0·1 c.c.: above 2 and below 4 c.c., a difference of 0·2 c.c.; and above 4 and below 5 c.c., a difference of 0·3 c.c.

The following are a few samples of different waters in which the iron has been determined as described above:—

think it right (whilst stating my experience of many years' duration to be that the Manchester Corporation water when cold does not take up lead from the pipes under ordinary circumstances) to guard persons from using for drinking purposes water drawn from hot-water cisterns made of lead.

My friend, Mr. Melland, Surgeon, of Rusholme, handed to me a white powder taken from the inside of the covering of his leaden hot-water cistern, which presented a honeycombed surface, and in many places stalactitic masses hung down which were from ¼ to ½ of an inch in length.

This powder consisted of a hydrocarbonate of lead, giving the following results of analysis:— -

Lead oxide (PbO)	85·67
Carbonic acid (CO_2)	12·12
Water (H_2O)	2·21
	100·00

It was doubtless formed by the solvent action of the

PARTS PER 1,000,000.

Date. 1874.	Name of Water.	Amount used in Analysis.	By New Method.	By $KMnO_4$.	As found by other Observers
Feb. 14	Manchester Water Supply	5 litres	0·21		0·287 R. A. Smith, 1864
Mar. 20	,, ,, ...	1 litre	0·18 }		
——	,, ,, ...	2 litres	0·175 }		
July 15	,, ,, ...	1 litre	0·10 }		
——	,, ,, ...	1 ,,	0·11 }		
Aug. 31	,, ,, ...	1 ,,	0·27		
Sept. 1	,, ,, ...	1 ,,	0·18		
,, 2	,, ,, ...	1 ,,	0·26 }		
——	,, ,, ...	1 ,,	0·27 }		
Sept. 3	,, ,, ...	½ ,,	0·30 }		
——	,, ,, ...	1 ,,	0·32 }		
Sept. 4	,, ,, ...	½ ,,	0·38 }		
——	,, ,, ...	1 ,,	0·36 }		
Sept. 5	,, ,, ...	½ ,,	0·42 }		
——	,, ,, ...	1 ,,	0·41 }		
Feb. 19	Medicinal Spring, Trefriew, N. Wales..	30 c.c.	1600·00	1575·50*	
Feb. —	Chloride of Iron Spa, Harrogate	50 ,,	290·00	290·34	289·40 H. Davies, Feb., 1872.
Feb. 16	River Irwell, near Pomona Gardens ..	¾ litre	0·86		
Feb. 18	River Mersey, Northenden	1½ litres	0·48		
Feb. 23	River Dane, above Congleton	1 litre	0·57		
——	,, below ,, ...	¾ ,,	0·44		
——	Liverpool Water Works, Compensa. Water, White Coppice Heapy .. .. }	2 litres	0·42		
Jan. 3	Barnsley Water Supply	2½ ,,	0·25		
Feb. —	River Thames, London Bridge	1 litre	0·19		
Jan. 3	Cockerham Well, Barnsley	2 litres	0·075		
Feb. —	New River Company	1 litre	0·050		Trace } Graham,
——	Lambeth	1 ,,	0·044 .		12·1 (Al_2O_3 & Fe_2O_3) } Miller, and
——	East London	1 ,,	0·038		6·8 (,, ,,) } Hofmann.
Jan. 3	Friars' Well, Barnsley	1¾ litre	0·005		

* The author hopes shortly to bring an analysis of this water before the Society.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, November 3, 1874.

Rev. WILLIAM GASKELL, M.A., Vice-President, in the Chair.

MR. WILLIAM CARLETON WILLIAMS, F.C.S.; Mr. Harry Grimshaw, F.C.S.; and Mr. William E. A. Axon, M.R.S.L., F.S.I., were elected Ordinary Members of the Society.

"*On the Corrosion of Leaden Hot-water Cisterns,*" by Professor H. E. ROSCOE, F.R.S., &c.

As the question of the occurrence of lead in town's water has been brought forward in the daily papers, I

condensed water containing oxygen upon the metal and the subsequent formation of the insoluble hydrocarbonate, and there can be little doubt that water drawn from such a cistern would be contaminated with lead.

"*On an Improvement of the Bunsen Burner for Spectrum Analysis.*" By F. KINGDON, Assistant in the Physical Laboratory, Owens College.

The students in the Physical Laboratory of Owens College having occasionally experienced some difficulty in obtaining the spectra of some salts with the ordinary Bunsen, through apparently a deficiency of pressure in the gas, it occurred to me that the amount of light even at this deficient temperature might be increased by multiplying the number of luminous points. This is accomplished by broadening out the flame of the Bunsen, that is, causing the gas to issue through a narrow slit instead of a round hole. We have, so far, only made a rough experiment, the slit being about ⅞in. long and ⅛in. wide. The result is, as expected, a more brilliant spectrum.

* *Journ. Prakt. Chem.,* 22, 51.

"*On the Existence of a Lunar Atmosphere.*" By DAVID WINSTANLEY.

The non-existence of a lunar atmosphere is spoken of by many astronomical writers as confidently as if it were a demonstrated fact. It is certain, however, that it is not a demonstrated fact, and it is certain, also, that if a fact at all, it is undemonstrable.

The failure of any optical test, however delicate, to detect the existence of such an atmosphere still leaves another alternative open to us than the inference of atmospheric non-existence, namely, the existence of an atmosphere in quantity below the minimum discernible by the means employed.

The non-existence of an atmosphere about the moon comparable in density with that which surrounds the earth, may indeed be regarded as an established fact; but the total non-existence of such an atmosphere is certainly an unwarranted conclusion.

I shall endeavour to show presently that the refraction of a ray of light is not the most delicate test which can be employed for the determination of the point in question. But even this test has yielded indications which astronomers of note have construed into evidence of a lunar atmosphere of considerable attenuation. Arago, for instance, has observed on more than one occasion the apparent adhesion of a star for three or four seconds to the dark limb of the moon after it had been perceived to be in contact with it, and he has also observed a very sensible diminution of brightness previous to immersion.

From the distortion of the visible segment of the solar disc, observed by Euler during the eclipse of 1748, Du Sejour, after making corrections for the effects of irradiation, arrived at the conclusion that the moon possesses an atmosphere having a horizontal refraction of 1·5", and which is therefore 1·400 times more rare than common atmospheric air upon the surface of the earth.

A phenomenon similar in kind to the twilight of the earth has been recognised by Shroeter, in the form of a faint crepuscular light extending from each of the lunar cusps along the circumference of the unenlightened portion of her disc, from which he has been enabled to deduce the existence of an atmospheric envelope about our satellite capable at an elevation of 5000 feet above her surface of causing a sensible inflexion of the light proceeding from a celestial body. But as the moon would describe an arc representing this amount in less than two seconds of time, "the circumstance has been adduced as affording a sufficient explanation of the difficulty of detecting a lunar atmosphere in the phenomena of occultations."

Chromatic dispersion is the test which in certain circumstances at any rate seems to offer better opportunities for ascertaining positively the existence of a lunar atmosphere than the test of simple refraction. It would cause the colour of an occulted object to change, making it green, and finally blue at the instant of disappearance.

The direct telescopic observation, by which alone this appearance could be noticed, would, from the operation of circumstances upon which I need not dwell, probably lead only to results of uncertainty. At the same time it is but proper to remark that appearances have been observed at eclipses of the sun suggestive of this phenomenon, and which have been interpreted by Flamsteed as indicating the existence of a lunar atmosphere. The particular circumstances in which, as I take it, chromatic dispersion may afford weighty evidence of the existence of a lunar atmosphere occur when the body occulted by the moon is one of considerable angular magnitude and great intrinsic splendour. Then it is manifest that the chromatic dispersion effected by such an atmosphere would cause the projections of prismatic bands upon the earth, forming, as it were, an iris on the borders of the shadow, and bathing the landscape and the clouds in all the rainbow hues. These circumstances it will be seen exist during the totality of a solar eclipse, and the rainbow hues bathing alike the landscape and the sky, which I have indicated as the inevitable consequences of chromatic dispersion by a lunar atmosphere, would seem to be almost constant accompaniments of such eclipses. "As early as the year 840 it was remarked that during the total eclipse of the sun which happened in that year the colours of objects on the earth were changed." "Kepler mentions that during the eclipse which occurred in the Autumn of 1590 the reapers in Styria noticed that everything had a yellow tinge," whilst during that which took place in 1706 objects were observed to change their colour, now appearing of an orange-yellow, and now of a reddish tinge.

The illustrious Edmund Halley remarked that the face and colour of the sky were changed during the eclipse observed by him in 1715. "The serene azure of the sky," he says, "turned to a more dusky livid colour, intermingled with a tinge of purple, and grew darker and darker until the total immersion of the sun." Sir John Clarke, in his account of the eclipse of 1737, states that "the ground was covered with a dark greenish colour," whilst in the eclipse of 1842 "it was *universally* remarked that the colours of terrestrial objects were changed." Mr. Hind says that after the totality had commenced "the southern heavens were of a uniform and purple grey." "In the zenith and north of it the heavens were of a purplish violet, while in the north-west and north-east broad bands of yellowish crimson light, intensely bright, produced an effect which no person who witnessed it can forget." "The crimson," he says, "appeared to run over large portions of the sky, *irrespective of the clouds*," a circumstance certainly suggestive of a cause differing from that which gives rise to the hues of sunset. "All nature," continues Mr. Hind, "seemed to be overshadowed by an unnatural gloom; the distant hills were hardly visible; the sea turned lurid red, and persons standing near the observer had a pale and livid look." Not only did the colours "run over large portions of the sky, irrespective of the clouds," but they were visible at stations so remote from one another as to give additional assurance of an extra-terrestrial origin. The *distribution* of the colours observed by Mr. Hind at Rævelsberg is consistent with the theory of their production by the chromatic dispersion of a lunar atmosphere, whilst the *order of their succession*, as stated by Sig. Piola who observed in Italy, and the sudden *change* of colours noticed by Mr. Lowe, and which took place as the shadow swept along, afford confirmation of the theory.

It has been suggested by Mr. Lockyer that the colours projected upon the landscape during the continuance of a total solar eclipse may be those of various layers of the chromosphere alternately disclosed by that great screen the moon in its passage over the solar disc. Manifestly, however, the purity of some of the colours would be interfered with, assuming them to be produced in this manner, and the yellow which is so frequently seen would seem to be unaccounted for. It is not unlikely that further and special observations will be required to say of either of these theories that it may or may not be maintained

In the meantime, considering that the non-existence of a lunar atmosphere is undemonstrated and undemonstrable, that it is in opposition to analogy, and that even simple refraction has given evidence of such an inconsiderable atmospheric envelope as we might at most expect a body of the moon's small mass to have, it certainly seems to me that the balance of probability lies in favour of the theory that the rainbow hues observed at total eclipses of the sun are really the results of chromatic dispersion effected by a lunar atmosphere.

CORRESPONDENCE.

GASEOUS VOLUMES AND SPECIFIC GRAVITIES.

To the Editor of the Chemical News.

SIR,—I am glad to see in your columns another communication on the above subject from Sir F. C. Knowles,

for the unfortunate datum in his original paper has probably drawn the attention of some of your readers from the views he sought to illustrate. Some of these views, by the mere fact of their statement by him, indicate either real ambiguity in the language of chemistry, or at least imperfect or erroneous enunciations in the books he consulted, while others are not without interest of a wider kind.

If in the two equations $A + B = C$ and

$$\frac{A}{a} + \frac{B}{b} = \frac{C}{c}$$

we assign to the letters the meanings mentioned in the original paper (CHEMICAL NEWS, vol. xxx., p. 199), the first equation, in which of course the sign = implies numerical equality, with all the consequences that result therefrom, is the expression of the widest inductive generalisation of chemistry, namely, that which affirms that the quantity of matter is unchangeable. But the second equation being as the obvious relation

$$\frac{\text{weight}}{\text{specific gravity}} = \text{volume}$$

indicates a statement to the effect that the volume of a compound gas is always equal to the sum of the volumes of its components before combination embodies a proportion to which no one acquainted with the elementary fact of chemistry would advisedly assent. It is indeed the algebraical form of the fallacy which the author supposed had obtained credit among chemists, namely, "that the numerical relation between the atomic weights and that between the atomic volumes are identical." I imagine that this notion was derived from some loosely worded statement of the fact that the same equation which expresses the relative weights of the substances concerned in a reaction, expresses also, if it be properly written, the relative gaseous volumes, *e.g.* :—

$$2H_2O + O_2 = 2H_2O$$
$$2NH_3 = N_2 + 3H_2$$
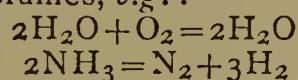
The sign of equality applies only to the ponderal relations, but the *coefficients* of the molecular expressions inform us also of the relative volumes concerned, while the sign = in regard to them merely separates the products of the reaction from the substances which enter into it. Some authors have expressed such volumetric results thus :—

$$2 \text{ vols.} + 1 \text{ vol.} = 2 \text{ vols.}$$
$$2 \text{ vols.} = 1 \text{ vol.} + 3 \text{ vols.}$$
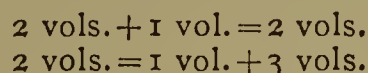
This appears a forced and unnecessary use of the sign of equality, for the short word "yield" would clearly express the real meaning. The adoption of (÷) the sign of division, in such relations, would be of advantage only in expressing condensation ratios. I believe also that our chemical notation which uses juxtaposition and the sign + with *different* significations, would lose immensely in clearness and compactness by the substitution of the additive sign for the former, and conformity to algebraic conventions would be dearly paid for by the confusing array of brackets which would become necessary.

The statement which, it appears, the author had in view when he applied the *reductio ad absurdum* test, does not present itself in the original paper in connection with the foot-note, which, as printed, is made to refer to quite another statement, namely, that from which I said that the value 0·414 as the density of carbon vapour was deducible. This number, Sir F. C. Knowles says, is inaccurate, being only half the correct value. But this number and the statement from which it is derived are as correct as those which he now substitutes in his letter. Both depend entirely in each case upon the atomic constitution we choose to attribute to the carbon-gas molecule, and experimental data, and adequate grounds for analogical reasoning are alike wanting, carbon-gas being purely imaginary so far as regards a direct determination of its density, and the element itself in many respects exceptional.

In the original paper the author desires "some happy hypothesis . . . to determine, *a priori*, the specific gravity of a molecule from the separate specific gravities of its constituent atoms," and in his letter he says—" If we are ever able to express the specific gravity of a compound in a function of the specific gravities of the components, all the latter must be included." No doubt. Unless I misunderstand his meaning, I think we already possess this happy hypothesis in that of Avogadro, as a consequence of which, when we know what are the constituent atoms of a molecule, we find the specific gravity (hydrogen = 1) by taking half the sum of the atomic weights. But as a matter of fact the hypothesis is worked the other way, for chemists constantly determine the molecular constitution from the specific gravity, which furnishes a criterion that other considerations may confirm, but which they are never permitted to overthrow. Let us suppose, however, that assuming the specific gravity of hydrogen gas as unity, we have ascertained that of carbon gas to be 12. Now any function of the numbers 1 and 12 which possibly could, in each particular case, express, *a priori*, the gaseous densities of the numberless compounds of hydrogen and carbon, must have a factor determined by some circumstances or property belonging to, and serving to identify, the hydrocarbon in question. If the numbers of the atoms of each constituent which build up the molecule are supposed known, we have already the author's desideratum; but, as already stated, chemists reason *from* the specific gravity to the molecular constitution. If it be not the latter which is to supply the particular factor for each case, in what circumstance peculiar to each hydrocarbon must it be sought ? What would be the gain to science were the specific gravity determinable *a priori* in each case, if the observations necessary for its determination should be of a more complicated character than the direct measurement of the density ? Even the advantage to theory which might accrue by thus establishing an invariable connection between density and the more complicated circumstances, would equally result from the tracing back of the connection from the more easily reached starting-point. It is, in truth, the gaseous density which furnishes (the percentage composition of a substance being known) the most reliable datum for the determination of the molecular constitution, and specific gravities derive all their importance in Chemistry from this fact. It would be interesting to learn from Sir F. C. Knowles by what more easily observed property or identifying circumstance he can imagine hydrocarbons (say) to furnish the additional factor for the desired function.—I am, &c.,

R. ROUTLEDGE.

London, November 30, 1874.

IRON IN CHAR.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS of November 27th, there appears a letter from Mr. Martin Murphy, of Liverpool, with regard to my paper on ferrous sulphide in char.

In Mr. Martin Murphy's communication there are one or two points which seem to concern me, and, with your permission, I will briefly refer to them in order :—

The amount of sulphur evolved from any char, as H_2S by means of HCl, does not express the total amount of that element existing in the state of sulphides. This I hope to show shortly as the result of experiment. Let Mr. Murphy, if he doubts, take a sample of any char rich in sulphides, and evaporate to dryness with HCl at 100°. Then let him digest the powdered residue with rectified carbon disulphide, whose purity has been previously verified. On evaporation, he will obtain a weighable amount of sulphur. I merely mention this in passing, as, with all due respect, Mr. M. Murphy's method of estimating sulphides appears rather antiquated. He grounds his disbelief of the existence of FeS in char, upon the

assertion that in certain samples he found too little iron o satisfy all the sulphur evolved by HCl. Well, whatever sulphur was left over should have been calculated as calcium sulphide. There are two kinds of sulphides, which, for the sake of using their names in a sugar-house, we may term—1. Temporary sulphur. 2. Permanent sulphur.

It is of the utmost importance to all refiners that chemists should most distinctly specify in their reports how much of each of these two sulphides any char contains.—1. Given, a char containing hardly any iron, when heated sufficiently to produce sulphides, of course they will be those of calcium. After passing through the round of treatment, on arriving at the kiln-head sulphides will be found absent. They are temporary, and easily removable.

2. Given, a char containing iron equivalent to the amount of sulphur originally existing as calcic sulphate on beginning the round. The iron will snatch the sulphur from the calcium in the event of the reduction of calcic sulphate, and no amount of routine sugar-house treatment will ever remove *ferrous* sulphide. It is quite permanent.

Between the two varieties occur many gradations. Some samples contain little or no FeS, and a large percentage of calcium sulphides ; more are of the permanent variety, and have *no* calcium sulphides present.

These statements are founded upon the sure ground of experiment, and Mr. Murphy must supply experiments in refutation.—I am, &c.

                     R. FRAZER SMITH.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 17, October 26, 1874.

Composition and the Physiological Properties of Coal-Tar.—M. Dumas.—The author examines coal-tar with reference to its power of destroying insects, and especially the phylloxera. He finds that its efficacy lies in the volatile constituents, and especially in the hydrocarbons boiling below 180°.

Eighth Note on the Electric Conductivity of Bodies of Medium Conducting Power.—Th. du Moncel.—In this paper the author examines the conducting power of tissues, which, being all more or less hygroscopic, yield very different results, according to the amount of moisture in the air, the hour of the day, and the temperature. In performing these experiments the specimens of tissues under examination have been interposed between two platinum electrodes, so that the resistance would be represented by their thickness. Silks and woollens gave unexpected results, for in all experiments made with a relatively low degree of moisture (36° of the hair hygrometer), woollens showed less conductivity than silk. Black silks caused the galvanometer to deviate sometimes 40°, whilst coloured silks left it unaffected. The dearest blacks produced the smallest deviation. It follows from these experiments that silks supposed to be insulators are not so ; and in dry weather woollens are superior as insulators, at least as regards voltaic currents. The apparent results of colour become intelligible when we learn that most black silks are *weighted, i.e.*, saturated with certain matters which combine with the silk, and increase its weight to the extent sometimes of 300 per cent. In the better class of silks the weighting ranges from 10 to 60 per cent. This increase of weight is generally produced by passing the silks alternately through baths of ron and of tannin. Hence such silks are covered with a hygroscopic and conductive layer. With coloured silks this practice does not prevail, as the manufacturers have not succeeded in weighting them beyond, at the outside, 10 per cent. The author raises the interesting question whether the electro-conductivity of black silks might not furnish an approximate method of determining the degree of adulteration, care being taken to experiment at a constant temperature and degree of moisture ? Linens absorb moisture from the air the most eagerly, and give the widest deviations. Cottons conduct well, though less perfectly than linens. The galvanometric indications are so precise for different kinds of woven tissues that it is possible by this means to detect silk or woollen stuffs mixed with cotton or linen. Thus common orléans (wool aud cotton) gave a deviation of 7°, whilst wool gave 0°, and jaconet of the same thickness 13°. The effects of polarisation are less distinct with tissues than with mineral bodies. As with feeble conductors they always present effects very different, according to the direction of the currents, the author was induced to make a series of special experiments, taking minerals as a starting-point. These experiments have presented the phenomenon of polarisation under a new light. It may, in fact, happen in these conditions that for a certain direction of the current of the battery the effects of polarisation occasion a successive augmentation of the intensity of the current, whilst for the opposite direction they occasion a considerable and very rapid diminution. It may even happen that the current remains invariable in spite of an energetic polarisation ; and, what is still more curious, the current of polarisation after the interruption of the current of the battery is more considerable in the first case than in the second. These effects are especially manifested in siliceous minerals.

Fermentation of Apples and Pears.—MM. G. Lechartier and F. Bellamy.—In a memoir presented to the Academy in November, 1872, the authors made known the results of experiments, showing that carbonic acid and alcohol originate in fruits kept in closed vessels, and secluded from the oxygen of the air, without the possibility of finding an alcoholic ferment in their interior. M. Pasteur deduces from his theory of fermentation the conclusion that the formation of alcohol is due to the continuation of the physical and chemical life of the fruit cells in new conditions, similar to those of the cells of ferments. Experiments on various fruits, carried on by the authors during the years 1872, 1873, and 1874, give results which the authors regard as a demonstration of this view.

Absorption of Gas by Iron Wires Re-heated to Redness and Quenched in Dilute Sulphuric Acid.—M. D. Sevoz.—In wire-drawing, when the maker has arrived at a certain gauge, he is obliged, in order to draw the wire finer, to re-heat to redness in cast-iron stoves, closed as hermetically as possible, and then to quench in water containing 2·3 per cent of monohydrated sulphuric acid. It often happens that iron wire which has undergone these two operations, for instance, at No. 18 (34-10ths of a millimetre), becomes brittle when it has reached No. 8 (13-10th). If the wire is broken, and the fracture plunged into a glass of water, rapid and numerous bubbles of gas are seen to escape. The author has collected this gas, mixed it with air, and obtained a distinct explosion, but has not been able to decide whether it is carbonic oxide or hydrogen. The presence of a small quantity of this gas renders the metal brittle. When the wire-drawers meet with pieces of brittle wire they ascertain, by putting saliva upon the fracture, whether the brittleness is due to gas. If this is the case they lay the wire aside for five to eight days, when the gas is found to have disappeared, and the wire rssumes its ordinary malleability.

Isomerism of Perbromide of Acetylen and Tetra-Bromated Hydride of Ethylen.—M. E. Bourgoin.—The author's experiments establish the isomerism of these two bodies.

Decomposition of Certain Salts by Water.—M. A. Ditte.—In this paper the author examines the decomposition of the nitrate of bismuth, $BiO_3,3NO_5,3HO$; the subnitrate, BiO_3,NO_5,HO; and the sesquichloride of antimony in contact with water. He finds that the subnitrate of bismuth, in contact with boiling water, is decomposed until the water contains about 4·5 grms. of free acid per litre. On exhausting this salt with boiling water we obtain a new basic nitrate, answering to the formula $2BiO_3,NO_5$, and having no marks of cystallisation.

On Electro-Magnets.—M. Deleuil.—The author, making investigations on the method of removing from the "slip" destined for the manufacture of porcelain the particles of iron which they contain, substituted electro-magnets for the permanent magnets previously employed. As, however, they require to be continually plunged into the slip, it is necessary to secure the electro-magnet against the penetration of the liquid into the coil. He constructed an electro-magnet, of which the middle and the two extremities are of iron, as well as the exterior armature, which covers the coil only in part. The two extremities of this armature are separated by a ring of brass, representing about the third of its length. The folds of the helix are perfectly secure, and during the passage of the current a magnetic mass is obtained, which readily withdraws all particles of iron from the slip.

Liebig's Annalen der Chemie und Pharmacie.
September 19, 1874.

Ludwigit—a New Mineral from Banat. — G. Tschermak.—Specimens of this mineral have been recently brought from Morawitza. It consists of fine, generally parallel fibres, whence recent specimens have a silky lustre. The colour is blackish green, but there is a modification almost black with a violet cast. It is very tough, and the fibres are not easily separated from each other. They are sometimes 8 centimetres in length. The mineral is accompanied by magnetite in the shape of small grains, which intersect the mass in threads and veins. Granules of calcite are also met with. In hardness the mineral is equal to apatite. Its sp. gr. ranges from 3·907 to 4·016. The streak is blackish green, but paler than the mass. The finest fragments, when examined under a power of 200 diameters, are transparent, with a greenish brown colour. Its composition is—

Boracic acid	16·09
Oxide of iron	39·92
Protoxide of iron..	12·46
Magnesia	31·69
	100·16

Glycerin Ether.—V. von Zotta.—Not adapted for abstraction.

Conversion of Benzol-Disulph-Acid into Terephthalic Acid.—R. Fittig.—The author maintains, in opposition to Prof. Barth, that benzol-disulph-acid yields only terephthalic acid, and not a trace of isophthalic acid.

Structure of Pinacolin.—A. Butlerow.—A hypothetical paper.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, No. 7, 1874.

Dilatations due to Electricity.—M. H. Streintz has made a series of experiments on the increment of length in bars of different metals traversed by electric currents. He finds that the galvanic current produces no other modification in the elasticity of a conducting wire than that caused by the rise of temperature occasioned. Under the influence of a current a conductor expands more than if it had been raised to the same temperature without the current. To this rule tempered steel forms the only exception. Galvanic expansion does not show itself immediately when the circuit is made, but gradually like the expansion occasioned by heat. Galvanic expansion does not appear to be the consequence of an electro-dynamic repulsion, but results rather from a polarisation of heat, or a change of direction of the calorific vibrations.

Falsification of Sugars.—The *Journal des Fabricants de Sucre* strongly denounces the fraudulent applications of caramel in the French sugar trade.

Reagent for Arsenic.—Prof. Hager recommends the following method for detecting arsenic in the colours of paper-hangings:—A little of the paper is steeped in a concentrated solution of nitrate of soda, obtained by dissolving this salt in a mixture of equal parts alcohol and water, and letting it dry. Then the paper is burnt upon a porcelain saucer. The combustion generally takes place quietly and without flame. Water is poured upon the ashes, potash in excess is added, and the whole boiled and filtered. Dilute sulphuric acid is added, and then permanganate of potash, which is added gently as long as the red colour disappears and give place to a yellow under the influence of heat. If the liquid becomes turbid it is filtered anew. It is let cool, and more dilute sulphuric acid added, and a small plate of pure zinc. This should be done in a flask, which is then stoppered with a cork having two slits. In one of these is placed a slip of paper, steeped in a solution of nitrate of silver; in the other, a piece of parchment moistened with sugar of lead. If arsenic is present the silver paper blackens. The lead paper only serves to detect sulphide of hydrogen.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 10, October, 1874.

Report on the System of Apparatus for Lighting the Gas Burners in the Hall of the National Assembly at Versailles.—M. Lissajous.—The burners are lighted by electricity. A Ruhmkorff coil of medium size, with an automatic mercurial interruptor, is set in action by a Leclanché battery of four elements, the zincs having a surface of 4 square decimetres. These are only equivalent to three Bunsen elements of a middle size, but their duration is much greater. Under the influence of this battery the coil gives sparks of 15 centimetres. To transmit the electricity to the different lustres a special wire is employed for each, but the return current passes through one common wire.

Utilisation of the Sewage Water of Paris.—M. Durand-Claye.—A lecture on the methods of dealing with sewage. He enumerates three—filtration, precipitation, and irrigation. The first he pronounces impossible. Of the second he speaks only in its crudest form, with sulphate of alumina alone. He pronounces it, however, to have given excellent results. Of irrigation he treats at some length, without, however, pointing out any method of meeting or escaping its serious difficulties.

MISCELLANEOUS.

The Royal Society.—The following is the list of the new Council elected at the anniversary meeting of the Society on the 30th ult. *President :* J. D. Hooker, C.B., M.D., D.C.L., LL.D. *Treasurer :* W. Spottiswoode, M.A., LL.D. *Secretaries :* Professor G. G. Stokes, M.A., D.C.L., LL.D.; and Prof. T. H. Huxley, LL.D. *Foreign Secretary :* Prof. A. W. Williamson, Ph.D. *Other Members of the Council:* Prof. J. C. Adams, LL.D.; the Duke of Devonshire, K.G., D.C.L.; John Evans, Pres. G.S., F.S.A.; Capt. Frederick J. O. Evans, R.N., C.B.; Albert C. L. G. Günther, M.A., M.D.; Daniel Hanbury, Treas. L.S.; Sir John Hawkshaw, M.I.C.E.; Joseph Norman Lockyer, F.R.A.S.; Robert Mallet, C.E., M.R.I.A.; Nevil S. Maskelyne, M.A.; C. W. Merrifield, Hon. Sec. I.N.A.; Prof. E. A. Parkes, M.D.; Right Hon. Lyon Playfair, C.B., LL.D.; A. C. Ramsay, LL.D.; Major-General Sir H. C. Rawlinson, K.C.B.; and J. Burdon Sanderson, M.D.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of manures, and in the apparatus employed therein. John Henry Johnson, Lincoln's Inn Fields, Middlesex. (A communication from Henri Antoine Prosper Lissagaray, chemist, Pantin, France.) March 11, 1874.—No. 885. This invention relates to the production of manure by the precipitation, in a solid and imputrescible form, whilst retaining its property of assimilation of the nitrogenous matter contained in solution in blood; and to the apparatus employed for that purpose, which apparatus is also applicable to the manufacture of other manures. In carrying out this invention it is proposed to effect the precipitation by means of mineral acids, such, for example, as sulphuric acid or chlorhydric acid; or of compounds, such, for example, as sulphate of alumina or sulphate of iron, or the two combined, which are mixed with the liquid blood, into which there has been previously introduced a soluble salt or compound, such, for example, as an alkaline sulphite or bisulphite, or alkaline earth; or in lieu therof, chloride of lime or other hypochlorite; the liberation of one of the constituent elements, say, for example, sulphurous acid or chlorine, by means of the acid or body having an acid reaction subsequently introduced into the liquid, effecting, by a reaction produced from molecule to molecule throughout the whole mass, the complete coagulation of the solid matter in the blood, and at the same time rendering such coagulated matter imputrescible. The precipitated matter is collected in any suitable filtering apparatus, and either pressed into the form of cakes, or dried in any suitable manner. The apparatus consists of two series of vessels, through which the blood and acid are respectively conducted to a common vessel below, in which their admixture is effected. These vessels are provided with suitable ball and other cocks for the purpose of obtaining a continuous and proportional discharge of the liquids, and of intercepting them as required.

Improvements in the treatment of the liquors used in scouring or cleaning wool. Edward Thomas Hughes, of the firm of Hughes and Son, patent agents, Chancery Lane, Middlesex. (A communication from Louis Gustave Ghilain Daudenart and Edmond Verbert, Rue du Progrès Schaerbeek, Brussels.) March 13, 1874.—No. 913. The object of this invention is, first, to extract the potash in a state of carbonate, which is its most valuable condition, by a process which is at once economical and expeditious; and, secondly, to completely extract the greasy matters which separate from the washing liquors. The process consists in the employment either of caustic baryta or strontia, the essential characters of which are, first, to effect the entire separation of the greasy matter; secondly, to extract the carbonate of potash contained in the washing liquors; and, thirdly, to effect the continuous revivification of the baryta and strontia employed.

Improvements in the manufacture of prussiate of potash and prussiate of soda, and in the means employed for collecting and utilising the gases and other substances emitted in the manufacture thereof. Samuel Nield and Benjamin Foster, both of Leeds, York. March 13, 1874.—No. 914. Materials are placed in iron retort and burnt as usual. Gases and other matters are conveyed into a receiver containing "liquor," consisting of alkali, acid, water, or their equivalents; a deposit of animal colouring matter and potash being left is used again, or employed for dyeing or otherwise. The gases may be used for illumination purposes.

NOTES AND QUERIES.

Tanning Rabbit's Skins.—Will you be kind enough, or any of your correspondents, to let me know the best way of tanning rabbit's skins, &c., with the fur on, as I am a great sportsman, and would like to know how to convert the gelatin of the skin into leather? Would a solution of tannic acid do?—D. LENNARD.

MEETINGS FOR THE WEEK.

SATURDAY, Dec. 5th.—Physical, 3. "On a Strophometer," by T. Hearson; "On a Method of Demonstrating the Expansion of Solids," by Prof. G. C. Foster; "On the Electrolysis of certain Metallic Salts," by Dr. J. H. Gladstone and Mr. A. Tribe.
MONDAY, 7th.—Society of Arts, 8. Cantor Lectures. "Alcohol: its Action and its Use," by Dr. B. W. Richardson, F.R.S.
—— Royal Institution, 2. General Monthly Meeting.
—— Medical, 8.
TUESDAY, 8th.—Civil Engineers, 8.
—— Photographic, 8.
WEDNESDAY, 9th.—Society of Arts, 8. "On the Protection of Buildings from Lightning," by Dr. R. J. Mann.
THURSDAY, 10th.—Royal, 8½.
—— Royal Society Club, 6½.
—— Society of Arts. Conference to discuss "The Steps to be taken to insure prompt and efficient measures for Preventing the Pollution of Rivers." The chair will be taken at 3 o'clock by the Right Hon. Lyon Playfair, C.B., M.P., F.R.S.
FRIDAY, 11th.—Quekett Club, 8.

THE CHEMICAL NEWS.

VOL. XXX. No. 785.

THE CONSTITUTION OF MUREXIDE.
By JAMES REOCH, M.A., M.B.

IN the CHEMICAL NEWS, vol. xxx., p. 179, I described some new facts in regard to murexide. The present paper is a continuation of these researches.

Prout was the first to regard murexide as the ammonium salt of a peculiar acid, which he named purpuric acid. Liebig denied the existence of this acid, and regarded murexide as an amide; but for many years chemists have reverted to Prout's view, on the double ground that murexide gives off NH_3 when treated with cold potash, and that other purpurates exhibit characteristic colours. My own experiments, however, are entirely in favour of Liebig's view. Gregory showed that, when 7 parts of alloxan and 4 parts of alloxantin were boiled in 240 parts of water, and added to 80 parts of amm. carb., murexide was abundantly produced. I have never failed to procure it in this manner, not only when amm. carb. was used, but with other ammoniacal salts, as the benzoate, oxalate, phosphate, and valerianate; from all these crystals of murexide are readily produced, and a deep pink colour with the sulphate, bromide, chloride, and iodide, though not the beautiful prismatic crystals.

The first objection, therefore, I would start to the purpurate theory is, that if purpurate of potash or soda be entirely analogous to murexide, how comes it that no colour is produced by adding this mixture of alloxantin and alloxan to a salt of potash or soda? I have tried sixteen salts of potash and thirteen of soda, and, though a reaction takes place in some of them—for the bicarbonates give off gas, and a precipitate is formed of long needles, different from alloxantin crystals, and similar in appearance to the needles of uric acid seen in very acid urines—yet the fluid and precipitate are colourless. I have examined more than 100 salts of different metals, chiefly pharmacopœial, and in none of them is there a precipitate analogous to murexide produced by the above mixture.

It is held, however, that the violet or indigo-blue colour produced by adding KHO to murexide shows that KHO displaces NH_3, and forms purpurate of KHO; but let any one put 5 m.grms. of murexide on a series of glass slides, and add a drop of water, of NH_3, of soda, and of potash, and examine microscopically, and he will find that in the first there is a slight pink tinge and the crystals are little affected; with the others there is a violet colour, in ascending depth and corresponding completeness of solution of the crystals. In fact, this small quantity of murexide, which is entirely dissolved in a drop of liq. potass., would require 12 c.c. of distilled water to dissolve it; for I find that murexide requires 2000 to 2500 parts of cold water for solution, and, though much more soluble in boiling-water, it is still more soluble in cold KHO.

It is scarcely fair, therefore, to compare the solution of murexide in water to that in potash. It will, however, be said that, even if the solutions be correspondingly diluted, yet the tint is different, the potash solution being violet and the other pink; but it must be remembered that the crystals have a double colour, being of a shining green on two of their faces, and of a red-brown on the other two, and that this violet tint, appearing when each of the three alkalies, NH_3, NaHO, and KHO, are added to murexide, and being deeper with soda than with NH_3, and deepest with KHO, corresponding with the solubility of murexide in these alkalies, it would seem much more likely that the violet tint depends on the peculiarly intimate nature of the solution, than on any substitution of KHO for NH_3; for how otherwise could the violet tint produced by adding NH_3 be explained, since it is evident that NH_3 cannot replace NH_3? If this theory be true, it would follow that no proof exists that cold KHO causes the evolution of NH_3 from murexide, for it cannot be detected by test-paper, but is a mere inference from the fact that the violet colour is produced in the cold. Further, when acetic acid is added to the violet KHO solution, it restores the pinkish red colour of murexide. It is difficult to see how this could be if KHO displaced the NH_3 and formed a new salt, but it is easily accounted for if the KHO be merely the agent of dissolving the murexide. Again, if murexide be boiled with KHO, at least one equivalent of NH_3 is rapidly given off, but the purple colour is at the same time destroyed and changed to pale yellow. It is hard to account for this on the purpurate theory, for murexide is not very unstable; it requires some weeks for a dilute solution to decompose, and it may be boiled for a considerable time without injury. If, therefore, KHO displaced NH_3 in the cold and formed a new salt, one would expect that the latter would be more stable, and yet a considerable quantity can be decolorised in two or three minutes. The fact is, boiling with NH_3, as well as NaHO and KHO, will destroy the colour of murexide and accelerate its decomposition, even in the cold; but it is improbable that this is caused by the substitution of NH_3, else NH_3 itself should have no influence.

Having stated these objections to the existence of purpurate of potash, I need not examine particularly the other so-called purpurates, but will merely state two causes which may have led to a belief in their existence. First, the varying nature of the crystals of murexide itself; their general form is prismatic, but they also occasionally assume the globular and other forms, and, indeed, are little inferior to uric acid itself in point of diversity of microscopical appearance. Secondly, alloxantin is a chief product of the decomposition, as well as formation, of murexide, as I showed in my former paper, and this body, whose reactions are so little understood, is the source of some coloured salts. Thus it gives an intense violet precipitate with baryta- or lime-water, and along with soda produces a blue colour with ferric chloride, which is little inferior in delicacy to sulphocyanide of potassium as a test for iron; with liq. bismuthi it gives a deep yellow, and with acid molybdate of ammonium a deep blue. It might, therefore, happen that some of the salts of alloxantin were mistaken for salts of purpuric acid. It is easier, however, to establish a negative conclusion as to what murexide is not, than to ascertain positively what it is. As I said before, I get it by adding a mixture of alloxan and alloxantin to the benzoate, carbonate, oxalate, phosphate, and valerianate of ammonia, slightly from the sulphate, and a colouration only from the bromide, chloride, and iodide; but, as Gregory long ago remarked, neither alloxan nor alloxantin give so much separately as the two combined—thus, by adding 100 m.grms. of alloxantin to 175 m.grms. of alloxan, I have obtained 64 to 85 m.grms. of murexide, but only 1 to 2 m.grms. from the same quantity of either separately.

I may here say that I do not make these estimates by weight, as other precipitates might be produced, but by comparing the intensity of the colour when dissolved in a large quantity of water with that produced by a given quantity of pure murexide. The fact that so much alloxantin produces such an insignificant quantity of murexide, and that what it does produce is decolourised in a few days, shows clearly that the ordinary theory expressed by the equation—

$$\underset{\text{Alloxantin.}}{C_8H_4N_4O_7} + 2NH_3 - H_2O = \underset{\text{Murexide.}}{C_8H_8N_6O_6,}$$
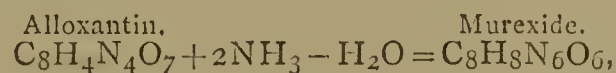
cannot be maintained; neither will alloxan alone account for its formation; and even the mixture of the two does not give more than a third of the quantity one might expect, if any simple equation were true. Moreover, aqueous alloxan alone will turn pink on standing, so that it contains the elements of decomposition within itself; and so, also,

will dry alloxantin exposed to the atmosphere. From uric acid, evaporated with nitric acid, not above $\frac{1}{15}$th of its weight of murexide, at the most, can be recovered ; and though I have not examined dialuramide, and other bodies capable of producing murexide, it is evident that, if a weight of murexide is not produced corresponding to the quantity of material used, the equations ordinarily given must be entirely hypothetical.

Further, no two analyses of murexide agree, and the ordinary formula is not derived from any analysis or combination of analyses, but from supposed views of its formation from different bodies. I have made several combustions of some commercial murexide which appeared very pure when examined microscopically. The mean of four experiments, as to C and H, gave 29·8 and 2·5, respectively ; while five determinations of the N, by volumetric analysis, gave a mean of 31·2. I am, therefore, disposed to propose a new formula for murexide.

	Calculated.	Experiment.
C_{10}	30·0	29·8
H_{10}	2·5	2·5
N_9	31·5	31·2
O_9	36·0	36·5
	100·0	100·0

It may be urged that this formula does not explain its formation ; but, when we are still ignorant of the rational formula of uric acid, and are absolutely ignorant as to the mode of its formation, it may well be supposed that the arrangement of atoms in murexide may long be undiscovered. At any rate, it seems better to rely on the result of the combustion-tube, than on a congeries of hypotheses as to its nature and reactions.

SOME REMARKS ON DALTON'S FIRST TABLE OF ATOMIC WEIGHTS.*

By Professor HENRY E. ROSCOE, F.R.S.

As the Society is aware, the first table, containing the relative weights of the ultimate particles of gaseous and other bodies, was published as the 8th and last paragraph to a paper by Dalton, "*On the Absorption of Gases by Water and other Liquids,*" read before this Society on October 21, 1803, but not printed until the year 1805. There appears reason to believe these numbers were obtained by Dalton after the date at which the paper was read, and that the paragraph in question was inserted at the time the paper was printed. The remarkable words with which he introduces this great principle give us but little clue to the methods which he employed for the determination of these first chemical constants, whilst in no subsequent publication, as in none of the papers which have come to light since his death, do we find any detailed explanation of how these actual numbers were arrived at. He says,† "I am nearly persuaded that the circumstance" (viz. that of the different solubilities of gases in water) "depends upon the weight and number of the ultimate particles of the several gases—those whose particles are lightest and single being less absorbable, and the others more, according as they increase in weight and complexity. An inquiry into the relative weights of the ultimate particles of bodies is a subject, so far as I know, entirely new. I have been lately prosecuting this enquiry with remarkable success. The principle cannot be entered upon in this paper ; but I shall just subjoin the results, as far as they appear to be ascertained by my experiments."

Here follows the table of the relative weights of the atoms :—

*A paper read before the Manchester Literary and Philosophical Society, November 17, 1874.

† "Manch. Mem.," vol. i., 2nd Series, p. 286.

Table of the Relative Weights of the Ultimate Particles of Gaseous and Other Matters.

Hydrogen	1
Azote	4·2
Carbon	4·3
Ammonia	5·2
Oxygen	5·5
Water	6·5
Phosphorus	7·2
Phosphuretted hydrogen ..	8·2
Nitrous gas	9·3
Ether	9·6
Gaseous oxide of carbon ..	9·8
Nitrous oxide..	13·7
Sulphur	14·4
Nitric acid	15·2
Sulphuretted hydrogen ..	15·4
Carbonic acid..	15·3
Alcohol	15·1
Sulphurous acid	19·9
Sulphuric acid	25·4
Carburetted hydrogen from stagnant water	6·3
Olefiant gas	5·3

In the second part of his "New System of Chemical Philosophy," published in 1810, Dalton points out under the description of each substance the experimental evidence upon which its composition is based, and explains, in some cases, how he arrived at the relative weights of the ultimate particles in question. Between the years 1805 and 1810, however, considerable changes had been made by Dalton in the numbers ; the table found in the first part of the New System being not only much more extended, but in many cases the numbers differing altogether from those given in the first table published in 1805. It is therefore, unfortunately, to a considerable extent now a matter of conjecture how Dalton arrived at the first set of numbers. All we know is that it was mainly by the consideration of the composition of certain simple gaseous compounds of the elements that he arrived at his conclusions, and in order that we may form some idea of the data he employed we must make use of the knowledge which chemists at that time (1803-5) possessed concerning the composition of the more simple compound gases.

As I can find no record of any explanation of these early numbers, I venture to bring the following attempt to trace their origin before the Society to whom we owe their first publication.

The first point to ascertain, if possible, is how Dalton arrived at the relation between the atomic weights of hydrogen and oxygen given in the table as 1 to 5·5 (but altered to 7 in 1808). The composition of water by weight had been ascertained by the experiments of Cavendish and Lavoisier to be represented by the numbers 15 of hydrogen to 85 of oxygen, and the result was generally accepted by chemists at the time, amongst others doubtless by Dalton. That in those early days Dalton had actually repeated or confirmed these experiments appears improbable. At any rate he formed the opinion that water was what he called a binary compound, *i.e.*, that it is made up of one atom of oxygen and one atom of hydrogen combined together. Hence if he took the numbers 85 to 15 as giving the composition of water, the relation of hydrogen = 1 to oxygen would be as 1 to 5·6, or nearly that which he adopted. It does not appear possible to explain why Dalton adopted 5·5 instead of 5·6 for oxygen ; it may perhaps have been a mistake or a misprint, as there are two evident mistakes in the table, viz., 13·7 for nitrous oxide instead of 13·9, and 9·3 for nitrous gas instead of 9·7.

Let us next endeavour to ascertain how he obtained the number 4·3 for carbon (altered to 5 in 1808 and 5·4 later on). Lavoisier, in the autumn of 1783, had ascertained the composition of carbonic acid gas by heating a given

weight of carbon with oxide of lead, and he came to the conclusion that the gas contained 28 parts by weight of carbon to 72 parts by weight of oxygen. Now Dalton was not only acquainted with the properties and composition of carbonic acid, but he was aware that Cruikshank had shown in 1800 that the only other known compound of carbon and oxygen, carbonic oxide gas, yields its own bulk of carbonic acid when mixed with oxygen and burnt; and also that Desormes* analysed both these gases, finding carbonic oxide to contain 44 of carbon to 56 of oxygen, whilst carbonic acid contained to 44 of carbon 112 of oxygen, being just double of that in the carbonic oxide. Dalton adds "this most striking circumstance seems to have wholly escaped their notice." Hence Dalton assumed that one atom of carbon is united in the case of carbonic oxide with one atom of oxygen, whilst carbonic acid possessed the more complicated composition and contains two atoms of oxygen to one of carbon. Now if carbonic acid contains carbon and oxygen in the proportion of 28 to 72, carbonic oxide must contain half as much oxygen, viz., 28 of carbon to 36 of oxygen, and assuming that the atomic weight of oxygen is 5·5 that of carbon must be

$$\frac{28 \times 5\cdot5}{36} = 4\cdot3.$$

Having thus arrived at the number 4·3 as the first atomic weight of carbon, it is easy to see why Dalton gave 6·3 as the atomic weight of carburetted hydrogen from stagnant water, and 5·3 as that of olefiant gas. The one represents 1 atom of carbon to 2 of hydrogen, the other 1 of carbon to 1 of hydrogen, or olefiant gas contains two equal quantities of carbon, only half as much hydrogen as marsh gas. This conclusion doubtless expressed the results of Dalton's own experiments upon these two gases which were made, as we know from himself, in the year 1894. He proved that neither of these gases contained anything besides carbon and hydrogen, and ascertained—by exploding with oxygen in a Volta's eudiometer—that if we reckon the carbon in each the same, then carburetted hydrogen contains exactly twice as much hydrogen as olefiant gas does, and that "just half of the oxygen expended on its combustion was applied to the hydrogen and the other half to the charcoal. This leading fact afforded a clue to its constitution." Whereas, in the case of olefiant gas, two parts of oxygen are spent upon the charcoal and one part upon the hydrogen.

The atomic weight of nitrogen (azote = 4·2) was doubtless obtained from the consideration of the composition of ammonia, whose atomic weight is given in the table at 5·2. Ammonia was discovered in 1774 by Priestley, but the composition was ascertained by Berthollet in 1775, by splitting it into its constituent elements by means of electricity, when he came to the conclusion that it contained 0·193 part by weight of hydrogen to 0·807 part by weight of nitrogen. Dalton assumed that this substance is a compound of one atom of hydrogen with one of nitrogen, and hence he obtained for the atomic weight of azote

$$\frac{807 \times 1}{193} = 4\cdot2;$$

and 4·2 + 1 = 5·2 as the atomic weight of ammonia. It is also probable that Dalton made use of the composition of the oxides of nitrogen for the purpose of obtaining the atomic weight of nitrogen. If we take the numbers obtained partly by Davy and partly by himself, as given on page 318 of the "New System," as representing the composition of the three lowest oxides, it appears that the mean value for nitrogen is 4·3 when oxygen is taken as 5·5. In all probability the number in this table (4·2) was obtained from an experiment of Dalton's made at an earlier date.

It is not possible to ascertain the exact grounds upon which Dalton gave the number 7·2 for phosphorus; its juxtaposition, however, in the table to phosphuretted hydrogen shows that it was probably an analysis or a density determination of this gas which led him to the

* *Ann. de Chimie*, T. 39, p. 38.

atomic weight 7·2, under the supposition that this gas (like ammonia) consisted of one atom of each of its components. In the second table, published in 1808, Dalton gives the number 9 as that of the relative weight of the phosphorus atom, and we are able to trace the origin of this latter number, although that of 7·2 is lost to us. On p. 460, Part II. of his "New System," Dalton states that he found 100 cubic inches of phosphuretted hydrogen to weigh 26 grains, the same bulk of hydrogen weighing 2·5 grains; hence, assuming that equal volumes contain an equal number of atoms, we have

$$\frac{26 - 2\cdot5}{2\cdot5} = 9\cdot4$$

gives the atomic weight of phosphorus nearly. It was probably by similar reasoning from a still more inaccurate experiment than this one that he obtained the number 7·2.

Sulphur, which stands in the first table of 1803 at 14·4, was altered in the list published in the "New System" to 13. These numbers were derived from a consideration (1) of the composition of sulphuretted hydrogen, which he regarded as a compound of one atom of sulphur with one of hydrogen, and (2) of that of sulphurous acid, which he supposed to contain one atom of sulphur to two of oxygen. Dalton knew that the first of these compounds contained its own volume of hydrogen, and he determined its sp. gr., so that by deducting from the weight of one volume of the gas that of one volume of hydrogen, he would obtain the weight of the atom of sulphur compared to hydrogen as the unit. The sp. gr. he obtained was about 1·23 (corresponding nearly he says—p. 451—to Thenard's number 1·23); hence (as he believed air to be 12 times as heavy as hydrogen) he would obtain the atomic weight of sulphur as (12 × 1·23) − 1 = 13·76, which number, standing half way between 14·4 as given in the first table and 13 as given in the second, points out the origin of the first relative weight of the ultimate particle of sulphur. So from sulphurous acid he would obtain a similar number, taking the sp. gr. as obtained by him (Part II., 389) to be 2·3, and remembering that this gas contains its own bulk of oxygen (p. 391), he obtained (2·3 − 1·12) × 12 = 14·16 for the atomic weight of sulphur. As, however, we do not possess the exact numbers of his sp. gr. determinations, and as we do not exactly know what number he took at the time as representing the relations between the densities of air and hydrogen (in 1803 he says that the relation of 1 : 0·077 is not correct, and that $\frac{1}{20}$ is nearer the truth) it is impossible to obtain the exact numbers for sulphur as given in the first table.

In reviewing the experimental basis upon which Dalton founded his conclusions, we cannot but be struck with the clearness of perception of truth which enabled him to argue correctly from inexact experiments. In the notable case, indeed, in which Dalton announces the first instance of combination in multiple proportion* the whole conclusion is based upon an erroneous experimental basis. If we repeat the experiment as described by Dalton we do not obtain the results he arrived at. Oxygen cannot as a fact be made to combine with nitric oxide in the proportions of one two by merely varying the shape of the containing vessel, although by other means we can now effect these two acts of combination. We see, therefore, that Dalton's conclusions were correct, although in this case it appears to have been a mere chance that his experimental results rendered such a conclusion possible.

ACTION OF LIGHT ON CERTAIN VANADIUM COMPOUNDS.†

By JAMES GIBBONS.

POTASSIUM divanadate, in combination with organic matter, is first rendered green, and ultimately blue by exposure to light, being reduced probable to the state of

* "Manch. Mem.," vol. 1, 2nd series, p. 250.
† A Paper read before the Manchester Literary and Philosophical Society, November 17, 1874.

vanadium tetroxide. The salt is not sensitive to light in the absence of organic matter.

Gelatine mixed with potassium divanadate, becomes slightly less soluble in warm water after being exposed to light ; this is apparent by the unexposed portions of the film swelling and dissolving more quickly when treated with water than the exposed parts.

If a colourless film of dry sodium orthovanadate (Na_3VO_4) free from organic matter, be exposed on glass to the sun for several hours, it only acquires a faint brown tint. The film kept in the dark with access of air for some hours, regains its normal colourless condition. The salt does not undergo any change when exposed to diffused daylight.

Paper, which does not contain any size of an animal origin, when coated with a solution of sodium orthovanadate, is darkened on exposure to light, the depth of tint depending on the length of exposure and on the strength of the solution used. The tint, however, never becomes darker than a slate colour.

If the paper thus prepared be immersed, after exposure to light, in a solution of silver nitrate, the colour in the exposed part instantly changes to a deep brown or to a black colour, varying according to the amount of exposure. A tint of the decomposed vanadate, which is of so slight an amount as to be with difficulty distinguished from the whiteness of the paper, will, by immersion in the silver nitrate, be toned so as to exhibit a very perceptible tint.

It is evident that paper prepared in this way might be employed for the purposes of photographic printing.

The unexposed parts are converted by treatment in the silver bath, into yellow silver vanadate. This substance may be dissolved out either by ammonia or by sodium hyposulphite. This act of fixing converts the dark brown or black part into those of a red colour. This may be prevented to some extent by using a bath of ammonio-silver nitrate, with an excess of ammonia, instead of the simple silver nitrate bath. The developed print can afterwards be toned with gold chloride.

The length of exposure required to produce a deep black is about one hour to a strong sunlight. This by using a solution of the sodium orthovanadate containing about 11 per cent of the salt.

Some ligneous substance only must be present with the sodium orthovanadate for the production of the above-mentioned slaty tint ; for if an albuminous body be present, a faint brown tint is produced after exposure to light, and the silver nitrate is not afterwards reduced to any very great extent. The slate colour of the reduced salt appears to be due to the formation of vanadium trioxide. If the exposed paper be kept for some weeks its colour changes to that of a yellowish brown, free vanadic acid appearing to be produced.

Gelatine impregnated with sodium orthovanadate exposed to light, and afterwards dipped into a solution of silver nitrate, becomes insoluble in hot water.

Silver orthovanadate is capable of forming a photographic image, which is nearly latent, and which may be developed by the ordinary ferrous developer used in photography.

To produce this image two or three minutes' exposure to sunlight is required. To develope it, it is essential that little or no silver nitrate be present ; otherwise, the exposed and unexposed parts are reduced indiscriminately. The washed silver vanadate can be mixed with a solution of gelatine containing a little albumen, spread upon paper, and allowed to dry ; it can then be exposed to light, and afterwards developed.

Alteration of Coal by Prolonged Exposure to Moist Air.—M. Varrenstrass finds that the loss of weight due to slow oxidation, and to the escape of gases rich in carbon, may amount to one-third of the original weight. The calorific power sustains in this case a loss of 47 per cent. In closed store-houses the loss of weight was only 25 per cent, and that of heating-power 10 per cent. Bituminous coals undergo the most rapid alteration.—*Les Mondes.*

SOCIETY OF PUBLIC ANALYSTS.

A General Meeting of the members of this Society was held on Tuesday, December 1st, at the City Terminus Hotel, Cannon Street, under the presidency of Professor REDWOOD.

The minutes of the previous meeting were read by the Secretary. A brief report was presented, stating what had been done by the Provisional Committee appointed at the Inaugural Meeting in August last, from which it appeared that the actual number of original members of the Society is now 63, only about fifteen public analysts throughout the kingdom having failed to avail themselves of the opportunity of joining without election. Since the beginning of October ten meetings had been held, the principal business transacted being the drawing up of a constitution for the Society, and the framing a definition of adulteration which should be at once comprehensive enough to include all actual adulterations, and at the same time sufficiently elastic to prevent oppression or injustice. To this end a great number of proposed definitions, submitted by some of the most eminent chemists in the kingdom, had been carefully considered and digested, and they had also been laid before experienced solicitors connected with local authorities whose legal experience, it was thought, would be valuable. The result had been circulated amongst the members in a printed form, but several suggestions had been received since, which appeared worthy of consideration before the proposed definition was adopted. The remainder of the report referred to the election of officers for the ensuing year, and the financial arrangements of the Society ; also to a contemplated arrangement with the editor of an established scientific journal for the use of a certain portion of space periodically in the interests of the Society.

Mr. WIGNER stated that he had received letters from many gentlemen throughout the kingdom, whose names he read, approving the objects of the Society, and regretting they were not able to attend.

Dr. TRIPE proposed the adoption of the report, which was seconded by Mr. G. TURNER, of Landport.

Mr. RIMMINGTON said he doubted whether it would be wise for them at present to propose for the adoption of Government any definition of adulteration. He feared whatever they might do would only be subject to criticism, and might very likely be pulled to pieces without producing any useful result.

The CHAIRMAN said he thought the discussion on this point had better be raised later, when the proposed definition was brought forward ; and the report was then unanimously adopted.

The CHAIRMAN then introduced the main business of the meeting, viz., the formation of a constitution for the Society. A printed copy of the one framed by the Committee had been circulated amongst the members, and its adoption he begged leave to move, being pleased to add that no alterations whatever had been suggested in it, though such had been invited.

Mr. WIGNER then proceeded to read the suggested constitution and rules, in the course of which Dr. TRIPE suggested that the number of honorary members should be limited ; and in answer to the same gentleman, the Chairman explained the manner in which the votes would be taken. The objects of the Society were stated to be as follows :—

1. To promote and maintain the efficiency of the laws relating to adulteration.
2. To promote, and as far as possible to secure, the appointment of competent public analysts.
3. To improve the processes for the detection and quantitative estimation of adulterations, and to secure uniformity in the statement of the results by holding periodical meetings for the reading and discussion of original papers on chemical and microscopical analysis, especially with reference to the detection of adulteration.

According to the proposed constitution, the Society will consist of members, honorary members, and associates, the members—in addition to public analysts—being analysts in actual practice, and the associates assistants of analysts, &c. A candidate for admission must be recommended in writing by four members, two of whom must testify to his fitness from personal knowledge. The election is to be conducted by means of voting papers, which may be forwarded by post; three-fourths of the votes, of not less than twelve members, being necessary for election. Members will pay an admission fee of one guinea, and an annual subscription of one guinea; associates will pay an annual subscription of five shillings, and be elected for a period of three years only, at the expiration of which time they may be again recommended for election. The affairs of the Society are to be managed by a Council, consisting of the President, two Vice-Presidents, Treasurer, two Honorary Secretaries, and not more than six other members.

A brief discussion arose as to whether membership was open to all analytical chemists, whether public analysts or not, and the Secretary read the resolution passed at the former meeting, showing that this was the intention of the meeting.

The next point on which a difference of opinion arose was on Dr. Tripe's proposal to limit the number of honorary members, and on a vote being taken it was decided by 11 to 3 that the number should not exceed twelve. With one or two verbal alterations, and the addition of a provision for summoning extraordinary general meetings on a requisition signed by eight members, the rules as printed were adopted on the motion of the Chairman, seconded by Mr. Wanklyn.

Mr. Cleaver and Mr. Piesse were appointed scrutineers to examine the balloting papers for the Council and officers of the Society, and whilst they were so engaged—

Dr. TRIPE moved a vote of thanks to the Committee for their past labours, which was seconded by Dr. MUTER, carried unanimously, and briefly acknowledged by the Chairman.

Mr. A. H. ALLEN drew attention to a compilation and classification of the evidence taken before the Adulteration Act Committee of the House of Commons during the last session, circulated semi-privately, he believed, by some gentlemen connected with the Grocers' Association, and read several questions and answers from the compilation referred to, which differed entirely from the authorised report as appearing in the Blue Book.

Mr. ESTCOURT (Manchester) also spoke of having noticed similar errors, some of which seemed to arise from something worse than carelessness.

The result of the scrutiny showed that the Council and officers proposed by the Committee had been elected by a large majority, the names being as follows :—

President, Prof. Theophilus Redwood, Ph.D.; Vice-Presidents, A. H. Hassall, M.D., and J. A. Wanklyn, M.R.C.S.; Honorary Secretaries, C. Heisch and G. W. Wigner; Treasurer, T. Stevenson, M.D.; other Members of Council, Messrs. Allen, A. J. Bernays, C. Estcourt, G. A. Rogers, M.R.C.S., F. Sutton, J. W. Tripe, M.D.

Mr. F. SUTTON (Norwich) moved that the annual meeting of the Society should be held on the first Tuesday in the month of February each year, that the ordinary meetings should be held on the first Tuesday in the months of March, May, and November, and that a provincial meeting should take place in August or September.

Mr. RIMMINGTON seconded the motion.

Mr. ALLEN suggested that the first week in the several months named be chosen, but that the day be left open. After some conversation this was agreed to, and the resolution was passed unanimously.

A resolution having been passed for the immediate payment of a subscription in order to defray the necessary preliminary expenses, the meeting adjourned for refreshments.

A few interesting novelties in analytical appliances were shown in the refreshment room.

On resuming business, the CHAIRMAN said the next question for discussion was the definition of adulteration —a very important subject, which would be introduced by Mr. Heisch.

Mr. HEISCH said the definition proposed had been already circulated amongst the members, and he hoped had been carefully considered: to show how far it was intended to be definitely adopted, he would read the resolution, which he should conclude by moving, viz.,

" That the following having been unanimously agreed to by the Committee appointed for the purpose, is considered by this meeting as a fair definition of an adulterated article, and they recommend it to the Council of the Society as one which may advantageously be *adopted as a guide.*" The definition was as follows :—

PROPOSED DEFINITION.

An article shall be deemed to be adulterated :—

A. In the case of food or drink—

1. If it contain any ingredient which may render such article injurious to the health of a consumer.
2. If it contain any substance that sensibly increases its weight, bulk, or strength, unless the presence of such substance be due to circumstances necessarily appertaining to its collection or manufacture, or be necessary for its preservation, or be acknowledged at the time of sale.
3. If any important constituent has been wholly or in part abstracted, without acknowledgment being made at the time of sale.
4. If it be a colourable imitation of, or be sold under the name of, another article.

B. In the case of drugs—

1. If when retailed for medicinal purposes, under a name recognised in the British Pharmacopœia, it be not equal in strength and purity to the standard laid down in that work.
2. If when sold under a name not recognised in the British Pharmacopœia, it differ materially from the professed standard. Proposed standards and limits for milk, skim-milk, butter, tea, cocoa, and vinegar, were then given.

In the first place, it would be observed that the Committee had not quite followed the instructions given them, to draw up a definition of adulteration, but, acting under what they believed sound legal advice, they had endeavoured to lay down what should constitute an adulterated article, leaving it open for other things to be considered adulterated or not, in the discretion of analysts and magistrates. Instead, therefore, of attempting to define adulteration in the abstract, they had said such and such things should be deemed to constitute an article adulterated, though not saying that nothing was to be considered unadulterated which did not come under those conditions. The Committee had had before it a definition much more sweeping than that now adopted, and he had at first been inclined to support it; but on consideration it was found that a schedule of exceptions to it would have been required, and it was ultimately rejected on that ground, though even the present one was not quite free from the same objection. It was, in his view, very important to bear in mind the distinction between defining adulteration and saying that certain things should be considered adulterated; because the latter left more discretion to analysts, and also to magistrates, who would, in many instances, be the final judges whether an article was adulterated or not. It had been found desirable to distinguish between drugs and articles of food or drink, and also to avoid the use of the word " add " in any shape. The Act was intended not only to protect the public health, but also to prevent imposition, and whether the adulteration arose from wilful fraud, or from ignorance or carelessness on the part of the

dealer, he believed the public were equally entitled to protection. The question of fraudulent intent would no doubt be considered by the magistrate in imposing the penalty; but such matters did not come properly within the scope of the analysts' functions, and they had therefore omitted any such words as either " add " or " fraudulently," simply defining an article to be adulterated if it contain such and such ingredients, or did not contain a sufficient proportion of certain others. Having read the definition as above given, he suggested that Clause A 4 might be added to B, and concluded by moving the resolution.

Dr. DUPRÉ having seconded it, *pro forma,*—

Mr. WIGNER read the various suggestions which had been received, the most important of which were—the addition of the word " foreign " in Clauses 1 and 2, and the substitution of " fraudulent " for " colourable " in Clause 4.

Dr. DUPRÉ said these definitions, although not put forward as final, had not been adopted without very mature consideration, and after repeated discussion of a great many suggestions, most, if not all, of which had been either adopted or distinctly rejected after examination. Indeed, many suggestions which at first sight seemed very reasonable, appeared on further consideration totally inadmissible. Thus the Committee had unanimously come to the conclusion that this was so with regard to the insertion of any such word as " fraudulently " or " wilfully," because it was hardly ever possible to prove a fraudulent intention, and the introduction of such words would practically render the Act a dead letter. Such points might very properly be considered by the magistrates, but had no place in a definition of adulteration, as applied to the article. Their object had been to make the definition sufficiently comprehensive to ensure the conviction of any one who so far tampered with any article as to make it injurious either to the health or pocket of the customer; but they had not found it practicable so to frame it as to include certain fancy articles, as they might be termed, which contained only an infinitely small amount of certain ingredients, and, if it had been practicable, he did not know that it would have been desirable. On the other hand, they desired to make their definition so elastic that it should not interfere unnecessarily or unfairly with the manufacturer or vendor. The proposal to add the word " foreign " to the first clause had been made in several quarters, but it had been distinctly rejected by the Committee, because its insertion would practically render it almost impossible to secure a conviction, there being such a vast number of ingredients present, in very minute quantities, that it would often be difficult to convince a magistrate that the adulterant was really foreign to the substance, and that it had been improperly added. Objections had been taken to Clause 1 that a teetotal analyst might be induced under it to certify that wine or beer was adulterated because it contained alcohol, which *he* deemed injurious to health; but this danger he thought entirely visionary. The insertion of the word " foreign " in Clause 2 would be even more objectionable than in Clause 1, and it might lead to great difficulty in the case of adulteration of milk with water; he suggested, however, that it would be improved by adding after the words " weight, bulk, or strength," the words " *or materially alters its apparent quality.*" The addition of alum to bread, or of Cayenne pepper to gin, could not be considered injurious to health, unless in considerable quantities, nor did it add to the weight or bulk, but it gave a deceptive appearance of flavour. The word " colourable " in Clause 4 he thought might with advantage be omitted altogether. He was sure the Council would welcome any further suggestions, and he would urge the meeting not to come to any absolute decision upon the matter, but simply refer the matter back to the Council for final revision.

Mr. SUTTON asked if it was intended to hand in this definition to the Chairman of the Local Government Board, the advisability of which he much doubted.

Mr. WIGNER said that was the ultimate intention, no doubt, but not at the present stage.

Mr. SUTTON said there appeared to be a great difficulty in fixing upon a definition which would meet the views of everybody, even amongst themselves, and still less the views of magistrates who had to administer the law; therefore, until they were asked for it, he did not think they should volunteer one to the Government. He had no doubt that any fresh bill which might be prepared would be so framed as to cover all things which it was considered desirable to prohibit, and then probably the analysts would be asked for information on matters coming within their own province. His own opinion was that some of their brethren had been much too particular, had drawn the line too stringently, and had not sufficiently considered the difficulties with which traders had to contend. If this sort of thing were pushed too far it would produce a spirit of antagonism which would result in no good to anybody. His experience was that the public really cared very little what they ate or drank, for there was hardly a case to be found in which the prosecution had not been initiated by the officers appointed under the Act.

Mr. RIMMINGTON agreed with Mr. Sutton, and thought they would make a great mistake in drawing up a definition which should either be handed to the Government or made public in any way.

Mr. PIESSE begged to differ *in toto* from the last two speakers. In his opinion both the public and the analysts would benefit greatly by a definition being drawn up on a subject upon which the greatest ignorance generally prevailed.

Dr. STEVENSON thought they would follow the wisest course in leaving this matter to the ultimate decision of the Council, though he saw no possible objection to the publication of the definition as at present framed. If they were as a body to ask for any alteration in the existing law, there could be no doubt they would be asked to state what their idea of adulteration was, and though they might not have framed their definition in strictly legal language, they ought to be in a position to state in plain English what their view of the question was. This definition was the product of a vast amount of labour and inquiry in all quarters, and he thought they could not do better than refer it back to the Council with their general approval.

Dr. TRIPE thought their course was quite clear. In the infancy of the Society they should not go before the public saying this or that is our definition of adulteration, but they should lay down something for their own guidance, so as to secure unanimity amongst themselves. The proper course, therefore, was to refer the matter back to the Council, as had been proposed.

Mr. WANKLYN said they must face the question before them. To refer back these definitions to the Council was to provisionally adopt them, and he certainly could not see that they would be going too far in so doing. With regard to the clauses under section A, they had simply adhered to the Act as it stood, and was being interpreted by the magistrates. A man was to be punished if he poisoned any article of food or drink, or if he diminished its value and cheated his customer, and these ideas were here carried out. He quite agreed in the remarks which had been made as to the impropriety of introducing the word " foreign," which would often prevent a conviction where it ought to be obtained, and also approved of the omission of the word " colourable."

Mr. ALLEN remarked that few gentlemen present probably were aware of the immense amount of labour which had been bestowed upon the framing of this definition. The Committee had obtained some twenty definitions from the leading chemists of the kingdom, and then having procured a list of the most frequent adulterations, had compared them, *seriatim,* with the definitions, to see which most fully met the case; they had then been revised by independent persons, and legal opinions also had been

obtained. He himself had come up to London six times since the end of September on the matter, and others had spent an equal amount of time and trouble upon it. He did not think the Government would be able to deal with the question in so thorough a manner. He still thought the phraseology capable of improvement, though he had been pretty well convinced, contrary to his previous impression, that the insertion of the word "foreign" would be a mistake.

Mr. RIMMINGTON having read a definition which he had drawn up, containing the words, "the same being done covertly to defraud and deceive the purchaser,"

Mr. HEISCH said that would be making the analyst judge and jury. They had decidedly come to the conclusion not to meddle with the question of intention.

Mr. RIMMINGTON thought it was necessary to show the intention in order to prove adulteration.

Dr. TRIPE said unfortunately his first two cases broke down on that very ground, but on fresh summonses being granted under section 2, instead of section 3, convictions were obtained.

Mr. WIGNER said he would read the opinion of a legal gentleman on this very point. He said, "How is it to be determined that water in butter has been *fraudulently* added or retained by the retailer?"

Mr. RIMMINGTON said it was to be determined by inference.

Dr. STEVENSON said he had had some cases break down on the question of *fraud*, and practically it was found useless to take out a summons under that section. The personal imputation was so great that hardly any local Board would prosecute, and magistrates would admit every possible excuse rather than convict; whereas, if it was simply a question of adulteration, a conviction was readily obtained, and very rightly in many cases. The old Act of 1860 was an illustration of this, for it remained a dead letter.

Mr. WANKLYN remarked that it was evident their duties were much simplified by the tacit admission of the magistrates, that persons who sold goods were bound to understand what they were dealing in. They had simply to testify as to the quality of the article, and, if it was not what it should be, the trader must suffer the consequences of his ignorance or carelessness.

Dr. MUTER said it was evident to all who knew anything about the working of the Act, that it would break down if fraudulent intent had to be proved. He was concerned in the first case ever brought under the Act, which was withdrawn on that ground under the advice of Mr. Poland. He thought the definition a very good one.

Mr. SUTTON wished it to be understood that he cordially approved of the definition for their own use, though he doubted the wisdom of too hastily publishing it or laying it before the Government.

The CHAIRMAN said he should like to make one or two remarks before putting the motion. In the first place, he thought it was very desirable, as had been so well explained to the meeting, that they should arrive as near as possible to a clear conception of what they thought would be a fair definition of an adulterated article. Having taken part in the discussions on this subject, and the more it was discussed the better, instead of becoming more confident in their ability to make, in every respect, a good, comprehensive, and explicit definition, he became more and more doubtful as to its possibility. In several respects his opinion had materially changed since he commenced looking at the question, and he regretted that even at the present time he was unable to entirely agree with the definition now put forward. He believed he had been the principal dissentient in the Committee, having entertained serious doubts from the first as to whether they had framed such a definition as it would be desirable to lay before the public. However, the resolution as proposed had avoided this difficulty, because they did not propose that the Society should be strictly tied down to the definition now brought forward;

but all agreed in this, that it was desirable they should indicate as far as possible, in intelligible terms, what were the conditions under which articles should be looked upon as adulterated. He was not quite satisfied, and did not think he ever should be, with this amount of success, because if they were to have a definition, he, for one, desired one which should cover all articles which could be considered as adulterated. and if they fell short of this, and found they could not frame a definition which would be so comprehensive as to take in everything, but at the same time elastic enough for purposes of commerce and manufacture, he should be inclined to come to the conclusion that they had better not have one at all, but simply depend upon the Act itself, which specified in so many words that if an article were adulterated in whatever way, not defining what that way should be, the seller was subject to a penalty. It was quite possible they might come to that conclusion at last, but he had originally entertained a strong opinion that without much difficulty they might frame a definition which would be both stringent enough on the one hand, and elastic enough on the other, to cover all cases which they required to take cognisance of. At the same time he must confess that the more he looked into the subject the more difficulties he saw. He thought, however, they would show a great amount of weakness if, as a body, they drew back from the attempt to do all that could be done towards defining what constituted an adulterated article. He hoped they would endeavour to do this, but their first object must be to do it for their own use, so that they might be able to agree amongst themselves, and further be in a position to enlighten the public upon the matter; but they must not decide too hastily what use to make of the definition when accomplished. The one now proposed was framed in popular rather than in strictly legal or technical language, but it gave a very good general idea of what was intended, and if the Society agreed to the resolution which had been proposed, that it should be sent back to the Council for further consideration, he thought that would be the best course that could be adopted.

The motion was then put and carried unanimously.

Section B, the discussion of which had been postponed until after Section A had been disposed of, was next brought forward, when

Dr. TRIPE proposed that in clause 2 the words " or its synonym " should be added.

Mr. RIMMINGTON said he doubted very much, with regard to many popular medicinal agents, whether it was not better for the purpose the more they were adulterated. Take, for instance, such articles as laudanum or sweet spirit of nitre. He believed, if they were sold of the pharmaceutical strength, there would very soon be a great many inquests required. In his part of the country persons were in the habit of taking sweet spirit of nitre by the ounce or half-ounce, and they would have great difficulty in convincing ignorant persons that they only ought to take a teaspoonful. The same thing with regard to spirit; he thought the more water there was in it the better.

Dr. TRIPE could not understand what the " professed standard " meant.

The CHAIRMAN said the name of the article, or the label affixed to it, might imply a standard. With regard to articles of medicine, not comprised in the "Pharmacopœia," there was a generally recognised composition which would be the professed standard.

Mr. WIGNER said if an article had no synonym it would be shut out altogether; and this was the case with many articles, such, for instance, as milk of sulphur.

Dr. TRIPE said milk of sulphur was the synonym for precipitated sulphur, according to Garrod.

Dr. STEVENSON said the professed standard did not mean that of the Pharmacopœia, but it meant that when the article referred to was something which had either an acknowledged standard as being a natural product, or was generally known as of a certain composition, it should

come up to that standard. It would introduce a great amount of confusion in the definition if they adopted the word "synonym," because there were many articles which, though approximating to the preparations in the British Pharmacopœia, had no synonyms, strictly speaking. Milk of sulphur for instance, was a recognised substance known to chemists as distinct from the substance known as precipitated sulphur, having long been prepared in a different manner. Paregoric, again, was not the same as compound tincture of camphor, which latter was really an imitation of paregoric. Of course if any article were the true synonym of one in the Pharmacopœia, the Pharmacopœia standard would be applied to it.

Dr. TRIPE said he would withdraw his suggestion.

Mr. PIESSE suggested the substitution of the word "its" for "the" before "professed standard," and a similar resolution to the last was then unanimously adopted with regard to section B. A somewhat lengthy discussion then ensued as to the latter part of the definition, and the proposed standards, which stated—

Various suggestions were made by members as to some of the details therein contained, and facts narrated as to the working of the Adulteration Act, particularly with regard to the sale of milk; ultimately a similar resolution recommending these standards to the Council for their guidance was adopted, but with the understanding that the word "limits" should be substituted for standards." A vote of thanks to the chairman concluded the proceedings, which had lasted over four hours.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.
Thursday, December 3rd, 1874.

Mr. W. H. PERKIN, F.R.S., in the Chair.

THE minutes of the previous meeting having been read and confirmed, and the names of the visitors announced, the certificates of Messrs. J. Martineau Poynting, George Turner, and Nathaniel Bradley were read for the first time. The following gentlemen were duly elected by ballot as Fellows of the Society, after their names had been read for the third time:—Messrs. Thomas Harrison, A. L. Sparkes, B.A., D. Kingsford, Edward William Parnell, Robert Hedderwich Ker, Arthur Deck, John Edward Morris, Roland H. Ridout, William Payne, William Griffin, and D. C. Mackenzie.

The first paper, "*On the Formulæ of the Alums*," was read by the author, Mr. S. LUPTON. He finds that ammonia-iron alum, $(NH_4)_2Fe_24SO_4,24OH_2$, loses $23OH_2$ at a temperature of 150° C., and becomes anhydrous at about 230° C. The alums $K_2Al_24SO_4.24OH_2$ and $(NH_4)_2Al_24SO_4,24OH_2$ both lose 23 molecules of water at temperatures of 180° C. and 190° C., respectively. These results prove that the formulæ of the alums given above cannot be halved, unless the improbable assumption be made that 2 molecules of alum coalesce in the formation of the mono-hydrated salts described by the author.

The CHAIRMAN having thanked the author,

Mr. W. N. HARTLEY read a note "*On the Colour of Cupric Chloride.*" He finds that the crystals of cupric chloride, $CuCl_2,2OH_2$, which are generally described as green, are really of a pale blue tint when rendered quite free from adhering moisture by exposure *in vacuo* over sulphuric acid. The green colour of the crystals, as ordinarily seen, he considers to be due to their being moistened with a film of the deep green solution of the salt. When examined by the dichroïscope, the light through the principal axis shows one image of an azure blue, and the other of an emerald green.

In reply to a question by Mr. C. E. GROVES, the author said he had not examined the light from the dark blue crystals and the moist green crystals by the spectroscope; there were considerable difficulties, owing to the small size of the crystals and their giving a continuous spectrum.

The CHAIRMAN then thanked the author in the name of the Society, after which

Mr. C. T. KINGZETT read Part II. of a communication "*On the Oxidation of the Essential Oils.*" The results of his more recent experiments induce the author to believe that the active agent produced by the atmospheric oxidation of oil of turpentine, which was described in the first part of the memoir, is probably an organic peroxide of the formula $C_{10}H_{14}O_4$, and that, on heating this product with water, peroxide of hydrogen and camphoric acid are formed, and remain in solution in the water.

$$C_{10}H_{14}O_4+2OH_2=C_{10}H_{16}O_4+H_2O_2.$$
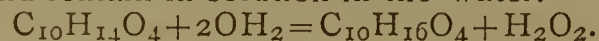
Acetic acid and formic acid appear to be formed at the same time.

The CHAIRMAN then thanked Mr. C. T. Kingzett in the name of the Society for his interesting communication on the nature of the products formed in the oxidation of oil of turpentine.

The two remaining papers were "*On the Purification and Boiling-Point of Methyl-Hexyl-Carbinol,*" by E. NEISON; and a "*Note on the Boiling-Point of Methyl-Hexyl-Carbinol,*" by C. SCHORLEMMER, F.R.S. The former finds that it is impossible to obtain the alcohol entirely free from the ketone which accompanies it, by means of treatment with acid sodium-sulphite, neither is the impurity removed by rectification with potassium hydrate; it then boils at 178° to 179° C. By digesting it, however, with potassium hydrate for a considerable time, the last trace of the ketone may be removed. After being carefully dried and rectified, it boils steadily at 181° C. Under some circumstances, the crude alcohol contains a small quantity of octylene and traces of octane. The former may be removed by the action of bromine, which converts it into octylene-bromide, a liquid of high boiling-point. The pure alcohol is an almost colourless, very mobile liquid, the density of which is 0·823 at 16°. Oxidising agents convert it into methyl-hexyl-ketone, and ultimately into caproic and acetic acids; heated with zinc chloride in a current of hydrochloric acid, it is rapidly converted into octylic chloride, a small quantity of octylene being produced at the same time.

Dr. SCHORLEMMER, by repeatedly distilling the alcohol, first from potassium hydrate and then from metallic sodium, obtained a liquid boiling constantly at 179·5°, the mercurial column being completely surrounded by the vapour, and the height of the barometer 756 m.m. The author finds that pure primary heptyl-alcohol boils at 155·5° C.

The CHAIRMAN, after thanking Mr. Neison and Dr. Schorlemmer, adjourned the meeting until Thursday, December 17th, for which there are communications from Dr. Schorlemmer, "On Groves's Method of Preparing Chlorides," and from Mr. J. L. Davies, "On the Precipitation of Metals by Zinc."

ROYAL INSTITUTION OF GREAT BRITAIN.
General Monthly Meeting, December 7th, 1874.

Admiral Sir HENRY J. CODRINGTON, K.C.B., Vice-President, in the Chair.

THE Hon. Mrs. Francis Wm. Buxton, William Henry Domville, Esq., and George Sampson, Esq., were elected Members of the Royal Institution.

The following Lecture arrangements were announced:—

John Hall Gladstone, Esq., Ph.D., F.R.S., Fullerian Professor of Chemistry, R.I.—Six Lectures, "On the Voltaic Battery," on December 29 (Tuesday), 31, 1874; January 2, 5, 7, 9, 1875.

Before Easter, 1875.

E. Ray Lankester, Esq., M.A.—Six Lectures, "On the Pedigree of the Animal Kingdom," on Tuesdays, January 12 to February 16.

Alfred H. Garrod, Esq.—Four Lectures, "On Animal Locomotion; including Locomotion on Land, in the Air, and in Water," on Tuesdays, February 23, March 2, 9, 16.

Professor P. M. Duncan, F.R.S.—Three Lectures, "On the Grander Phenomena of Physical Geography," on Thursdays, January 14 to 28.

Professor Tyndall, D.C.L., LL.D., F.R.S.—Seven Lectures, "On Subjects connected with Electricity," on Thursdays, February 4 to March 18.

Edward Dannreuther, Esq.—Two Lectures, "On Mozart and Beethoven (with Pianoforte Illustrations)," on Saturdays, January 16 and 23.

J. T. Wood, Esq.—Four Lectures, "On the Discovery of the Temple of Diana, and other Results of the Government Excavations at Ephesus," on Saturdays, January 30, February 6, 13, and 20.

Professor W. K. Clifford, M.A., F.R.S.—Four Lectures, "On the General Features of the History of Science," on Saturdays, February 27 to March 28.

The Friday Evening Discourses before Easter will probably be given by the following gentlemen :—January 15th, Professor Tyndall, D.C.L., LL.D., F.R.S., "Some Acoustical Problems." January 22nd, Sir John Lubbock, Bart., F.R.S., M.R.I., "Wild Flowers and Insects." January 29th, Professor Huxley, LL.D., F.R.S., "Recent Work of the *Challenger* Expedition, and its Bearing on Geological Problems." February 5th, James Dewar, Esq., F.R.S.E., "Physiological Action of Light." February 12th, W. R. Greg, Esq. February 19th, Professor Frankland, F.R.S., M.R.I., "Climate." February 26th, W. R. S. Ralston, Esq., M.A., "Popular Tales : their Origin and Meaning." March 5th, The Lord Rayleigh, M.A., F.R.S., M.R.I. March 12th, Professor Abel, F.R.S., "Accidental Explosions." March 19th, Richard Liebreich, M.D., M.R.C.S., M.R.I., "The Real and Ideal in Portraiture."

CORRESPONDENCE.

THE NEW SCIENCE SCHOLARSHIPS AT OXFORD.

To the Editor of the Chemical News.

SIR,—Much high-toned discussion recently took place when our great universities first established scholarships for the promotion of scientific study, and it it is now quite permissible to ask what these scholarships really are, and in what manner they are administered.

A specimen has recently come under my notice which, if at all typical of the remainder, is perfectly horrifying. This is the first, and presumably the simplest, chemistry paper, given for an *entrance* scholarship at Oxford :—

CHEMISTRY. I.

1. Discuss the methods and aims of Physics in contrast with those of Chemistry, and show the directions in which the one branch of study assists the other.

2. Give a history of the atom since the year 1800.

3. What reasons are there for belief in the duality of elementary molecules?

4. "The theory of polyatomic radicles and the theory of types are necessary to each other." Examine this statement.

5. The specific heat of a certain metal is 0·057 : the metal forms an oxide containing by weight 1 part of oxygen to 4·725 of metal, and a chloride containing 1 part of chlorine to 1·064 of metal. Wht formulæ probably represent these compounds?

(*Balliol College, Brackenbury Scholarship,* 1874.)

The other two papers, as well as the practical part of the examination, clearly exhibit either non-acquaintance with the routine of laboratory work on the part of the examiner, or a desire to ignore the same. The papers are too lengthy to give here, still, I cannot refrain from quoting one of the questions on organic chemistry :— "What are the chemical characters of soap, sugar, starch, gun-cotton, nitro-glycerine, tallow, and paraffin ?"

Is this, alas ! the chemistry expected from young students about to undergo a course of university study ? Is a *mere memory* of undigested facts to take the place of real knowledge obtained from the facts themselves ? for such is the real issue. Can any youth possess at the same time such unlimited book-knowledge, and yet be at all adept in chemical methods ?

And, in conclusion, allow me to ask what kind of "chemist" will emerge from the university if they be already so "super-saturated" with book-knowledge when they enter ?—I am, &c.

EXPERIMENT.

WANT OF COURTESY.

To the Editor of the Chemical News.

SIR,—I wish, through the medium of your paper, to point out an act of great injustice perpetrated by those who advertise for Managers, Chemists, Foremen. &c.

In a great majority of cases, and I speak on the authority of several persons who fill the positions above-named, the firm advertising open out a correspondence with some of the applicants, and it may be that several letters pass between them, and, after all, nothing more is heard from the advertisers; they cease to write, and the applicants are consequently kept in an unenviable state of suspense. Now, sir, would it not be better and more gentlemanly on the part of the advertisers to inform the applicants that their vacancies have been filled, and that their services are not required ? So long as advertisers continue to treat applicants so unceremoniously, they will never get really competent men to countenance them,—I am, &c.

A CONSTANT READER.

North Shields, December 2, 1874.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 18, November 2, 1874.

Researches on the Dissociation of Crystalline Salts. —MM. P. A. Favre and C. A. Valson.—A complete abstract of this paper cannot be given without the accompanying tables. When a hydrated salt dissolves the increase of the volume of the liquid differs, in general, little from the volume of the salt. The three or four first equivalents may give rise to a slight coercitive action, but this ceases, and the increase of the volume becomes constant. In this respect the solution of a hydrated saline crystal may be compared to the melting of a crystal of ice in water, which is accompanied by a slight contraction.

Modification of the Liquids of Fehling and Barreswill, as Employed for the Determination of Glucose.—M. P. Lagrange.—The author proposes the following formula :—

Dry neutral tartrate of copper ..	10 grs.
Pure caustic soda	400 ,,
Distilled water..	500 ,,

The tartrate of copper is obtained by decomposing the sulphate of copper with neutral tartrate of soda, the precipitate being washed by decantation, and dried at 100° C.

Fermentation of Fruits.—MM. G. Lechartier and F. Bellamy.—The authors have submitted cherries, gooseberries, figs, lemons, cherry and gooseberry leaves, chestnuts, and barley to experiments similar to those already performed with apples and pears. The results were identical. They draw the following conclusions :—At the

moment when the fruit, the grain, or the leaf is severed from the plant life is not extinct in its component cells. This life is accomplished, in the exclusion of air, in consuming sugar, and in producing alcohol and carbonic acid. As soon as the production of the latter ceases all vitality is extinct in their cells. Fruits, seeds, and leaves may therefore remain indefinitely in an inert state if no organic ferment is developed in their interior. Beet-roots and potatoes present a special phenomenon. As regards the production of alcohol and of carbonic acid they behave like fruits. They do not contain any alcoholic ferment, but in the acid liquid which saturates the mass of their softened tissues, the authors have recognised bacteria of different sizes.

No. 19, November 9, 1874.

Researches on the Dissociation of Crystalline Salts. —MM. P. A. Favre and C. A. Valson.—The coercitive action which a crystalline salt exerts on its water of crystallisation is not of the same order as the coercitive action exerted by the same salt, when dissolved, upon the mass of the solvent. In the former case the salt, in isolating itself from the medium, retains a definite number of equivalents of water, and its action consequently follows the law of definite proportions. In the second case the action is exerted upon the entire mass of the solvent, and consequently in indefinite proportions. When a dissolved salt crystallises in a saturated solution the phenomenon is generally accompanied with augmentation of volume, and at the same time with disengagement of heat. The influence of temperature upon the number of equivalents of water retained by the crystal must be noticed. Thus sulphate of soda, at common temperatures, takes up 10 equivalents of water : at a sufficiently elevated temperature the number of equivalents decreases ; and above 33° a saturated solution deposits the salt in the anhydrous state. It would, therefore, seem that the action of heat upon saline solutions may be compared to that which it exerts upon the systems formed by carbon and the gases which it condenses. If we admit that the coercitive action of salts upon water decreases with the temperature we may explain the increase of solubility with temperature for the majority of salts. Indeed, if we set out with a solution saturated at the ordinary temperature, and raise the temperature, the coercitive power of the salt diminishing, it necessarily follows that one portion of the mass of the water escapes entirely, or almost entirely, from the coercitive action of the salt, and is thus ready to undergo the coercitive action of a new portion of the salt, which then enters into solution. We may add that in raising the temperature more and more, the coercitive action becoming more and more feeble, we reach a limit beyond which a portion of the salt is deposited. This explains the maximum of solubility for certain salts. We conceive, finally, that at still higher temperatures the coercitive action may become =0, and the salt be then entirely deposited in the anhydrous state. With the greater part of salts which fix water of crystallisation the solution of these hydrated salts takes place without any sensible variation of the entire volume, when the liquid is sufficiently concentrated, which is generally the case with the third or fourth equivalent of the salt added. With anhydrous salts this is no longer the case. Hence it follows that the number of equivalents of water which a salt retains at the moment when it crystallises depends on this condition—that the solution of the salt is effected without change of volume. Lastly, let us consider the coercitive action, A, which an anhydrous salt exerts upon the indefinite mass of the solvent water compared to the coercitive action, B, exerted by the salt upon the definite proportion of water necessary for the constitution of the crystal. If these two actions are equal the hydrated and crystalline salt dissolves without alteration of volume. If A is greater than B there will be increase of volume in crystallisation, and decrease in case of solution. If B is greater than A the case will be reversed.

Method Adopted for the Discovery of the Substance Most Effectual Against the Phylloxera at the Viticultural Station of Cognac.—M. Max Cornu.

Certain Geometric Constructions Applicable to Mirrors and Lenses.—M. J. Lissajous.—A mathematical paper, unsuited for abstraction.

Preparation and Properties of Dioxy-Maleic Acid. —M. E. Bourgoin.—This acid is formed by heating a dilute solution of bibromo-maleic acid to 160° for six hours in a closed vessel. The acid is soluble in water and alcohol, but scarcely soluble in ether. Its alkaline and alkaline earthy salts are soluble in water. Its existence completes a remarkable series. There are three acids— the succinic, malic, and tartaric, to which correspond respectively the maleic, oxy-maleic, and dioxy-maleic, containing two equivalents less of hydrogen.

Studies Relative to the Phylloxera : Experiments made on Vine Branches Immersed in Water holding Various Substances in Solution.—A. Baudrimont.

Laws of the Vibratory Movement of Diapasons.— M. E. Mercadier.—Not adapted for abstraction.

Electro-Static Induction Currents.—M. Neyreneuf. —Verdet and Masson have made use of the electric egg to determine the direction of the induced current. The author has repeated their experiments, making use of the discharge of a Holtz machine, and has established without difficulty that the direction of the induced current varies with the intensity of the inducing charge.

Action of the Electric Current on the Organs of the Senses.—T. L. Phipson.—It results from experiments made by the author that the action of a galvanic current on the organs of sensation always appears at the positive pole, except at the moment where the negative pole becomes in turn positive, and then an action takes place at this pole. He thinks that in these facts is found the indication of a general law applying equally to the muscular contractions occasioned by electricity, and very probably to the phenomena of induction. If we take a small zinc-copper couple, plunged in acidulated water, and furnished with a platinum rheophore, and place first the zinc pole on one side of the tongue, and then the copper pole on the other side, the well-known and peculiar taste is immediately experienced at the point touched by the copper, but not on the other side. The result is the same if the positions of the poles are changed. If a stronger apparatus is used the phenomena are unaltered, but another fact is also observed—on removing the copper pole the same taste is experienced at the zinc pole. Corresponding phenomena are observed in experimenting on the organs of hearing, smell, and sight.

Reply to a Recent Paper by M. Gernez on Supersaturation.—M. Lecoq de Boisbaudran.—A controversial paper, having reference to *Comptes Rendus*, p. 912.

New Observations Relative to the Circular Compass.—M. E. Duchemin.—The author requests the opening of a sealed paper deposited with the Academy October 27, 1873, in which he describes the construction and the advantages of the circular compass.

Lamp of Sulphide of Carbon and Nitric Oxide, with its Application to Photography.—MM. B. Delachanal and A. Mermet.—If binoxide of nitrogen is kindled in a flask containing the vapour of sulphide of carbon a dazzling light is produced, which immediately causes the mixture of hydrogen and chlorine to detonate. The violet-blue tint of the light proves its richness in the chemical rays. The authors give a description of the lamp, and of experiments made with its light, which proves to be well adapted for photographic purposes. The spectrum of the light is very analogous to that of sulphur.

Chemical Nature of Bodies in the Organism which Exhibit a Cross under the Polariscope.—MM. Dastre and Morat.—In the yolk of the egg of birds are found spherical corpuscles presenting, when examined under

the polariscope, a cross whose limbs enlarge as they diverge from the centre. M. Dareste, who discovered these bodies in 1866 in the eggs of birds, has since found them in other animals—tortoises, osseous fishes, &c., and in various parts of the organism. R. Wagner has found them in the *vesiculæ seminales*, and M. Balbiani in the adipose body of the silkworm. M. Dareste considered them as animal starch, and believed that he had transformed them into glucose, making use of this supposed fact as an argument against the localisation of glucogenesis in the liver. The researches of the authors prove that these bodies consist of lecithine, a nitrogenous and phosphorised principle made known by Gobley. It is interesting to find a nitrogenous matter—considered as amorphous, and of a viscid and colloid nature—present a great number of the essential properties of crystals, assuming constantly a regular and symmetrical geometric figure. Lecithine is very distinct from starch; it is not turned blue by iodine; it dissolves in alcohol, and is precipitated by water, whilst the behaviour of starch is quite the reverse. The polarisation-cross being, therefore, not peculiar to starch, its value in proximate organic analysis is not greater than that of an ordinary crystalline form.

Liebig's Annalen der Chemie und Pharmacie.
October 17, 1874.

Behaviour of Iodine with Arsenious Acid.—M. Wegner.—The author undertook the investigation of this subject with reference to a paper by Prof. Zinno (*Buchner's Repertorium*, Heft 7, 1873) on iodarsenic acid. He is unable to confirm the results of Zinno, and doubts the existence of iodarsenic acid.

Ammonia Derivatives of Aceton.—W. Heintz.—A very elaborate account of triacetonamin, triaceton-ammonium-platino-chloride and subchloride, hydrochlorate of triacetonamin, diacetonamin, the two platino-chlorides of diaceton-ammonium, hydrochlorate and sulphate of diacetonamin, and dehydro-triacetonamin.

Certain Formation of Diphenyl within the Molecule.—C. Graebe.—This paper treats of the synthesis of carbazol from diphenylamin; the behaviour of methyl-diphenylamin with heat; of diphenylen-sulphide; diphenylen-sulphon; the behaviour of diphenyl-disulphide with heat; diphenylen-oxide; and diphenylen-methan.

Notice of a Palladium Salt.—The salt in question is a double sulphite of protoxide of palladium and of soda. When dried and washed it is a pale yellow crystalline powder. When heated it becomes yellow, and is then decomposed and blackened. In boiling water it is dissolved and decomposed. It consists of—

Oxide of palladium	20·40
Soda	30·49
Sulphurous acid	42·35
Water	6·76
	100·00

On Diphenyl.—Gustav Schultz.—This valuable paper treats of the preparation and properties of diphenyl; of its mono-substitution products, including brom-diphenyl, $C_{12}H_9Br$; chlordiphenyl (diphenyl-mono-sulphuric acid, oxidiphenyl): nitro-diphenyl, $C_{12}H_9.NO_2$, and meta-nitro-diphenyl; amido-diphenyl, $C_{12}H_9NH_2$; diphenyl-carbonic acid (para-phenyl-benzoic acid), $C_{12}H_9CO_2H$; the di-substitution-products of diphenyl, including dibrom-diphenyl; isobrom-nitro-diphenyl; dinitro-diphenyl, $C_{12}H_8(NO_2)_2$; amido-nitro-diphenyl, its behaviour with oxidising and reducing agents; iso-dinitro-diphenyl, iso-amido-nitro-diphenyl, diamido-diphenyl (benzidin); on the hydrocarbons given off as secondary-products during the preparation of diphenyl, both by Fittig's and Berthelot's method; diphenyl-benzol, $C_{18}H_{14}$; and iso-diphenyl-benzol.

Communications from the Laboratory of the University of Innsbruck.—These communications consist of a paper on the constitution of dioxybenzoic acid, by L.

Barth and C. Senhofer; and one by the last mentioned chemist on benzol-trisulphuric acid.

Investigations on the Volume Constitution of Solid Bodies.—Dr. H. Schröder.—The author examines the di- and trichromates of potash; the normal volume of chlorine; the isosterism of the magnesian chlorides and of mercuric chloride; of the anhydrous bromides of the magnesian metals and of mercury; and the normal volume of bromine.

MISCELLANEOUS.

University of London.—The following are lists of the candidates who have passed the recent examinations:—Second B.A. and Second B.Sc. Examinations. Examinations for Honours. *B.A. and B.Sc. conjointly.* —*Mathematics and Natural Philosophy.*—First Class— M. J. M. Hill, B.A. (Scholarship), University College; J. M. Lightwood,* B.A., Trinity Hall, Cambridge. *Logic and Moral Philosophy.*—First Class—J. N. Keynes, B.Sc. (Scholarship), Univ. Coll., Lond., and Pemb., Camb. Second Class—J. Beaston, B.A., private study; R. F. Ferguson, B.A., Univ. Coll.; S. G. Kelly, B.A., New Coll Third Class—P. K. Ráy, B.Sc., Univ. and Manch. New Colls., and School of Mines; E. P. A. Law, B.A., Univ. Coll.; J. S. Lidgett, B.A., Univ. Coll.; C. E. Moyse, B.A., Univ. Coll.; J. W. Richards, B.A., New Coll.; T. M. Williams, B.A., Univ. Coll. of Wales and private study. *B.Sc. only.*—*Chemistry.*—First Class—P. P. Bedson (Scholarship), Owens Coll. Second Class—S. A. Hill, Royal School of Mines; B. A. Whitelegge, Univ. Coll. *Geology and Palæontology.*—First Class—S. A. Hill (Scholarship), Royal School of Mines; A. H. S. White, B.A., Univ. Coll. Second Class—P. P. Bedson, Owens Coll.; P. K. Ráy, Univ. and Manch. New Colls., and Royal School of Mines. Third Class—B. A. Whitelegge, Univ. Coll. *Zoology.*—First Class—F. H. Barling, Owens Coll.

NOTES AND QUERIES.

Artificial Tannin.—Many years ago, Hatchete obtained a resinous tannin-like substance by the long-continued action of dilute nitric acid upon charcoal. I shall be much obliged if any of your readers can refer me to any subsequent investigations as to its nature and constitution, or that of the similar substances produced by the action of sulphuric acid on peat, camphor, &c.—HENRY R. PROCTER.

MEETINGS FOR THE WEEK.

MONDAY, 14th.—Society of Arts, 8. Cantor Lectures. "Alcohol: its Action and its Use," by Dr. B. W. Richardson, F.R.S.
—— Medical, 8.
—— Royal Geographical, 8½.
TUESDAY, 15th.—Civil Engineers, 8.
WEDNESDAY, 16th.—Society of Arts, 8. "On the Sandblast, and its Application to Industrial Purposes," by W. E. Newton, Esq.
—— Meteorological, 7.
—— Geological, 8.
THURSDAY, 17th.—Royal, 8½.
—— Chemical, 8. "On Groves's Method of Preparing Chlorides," by C. Schorlemmer; "On the Precipitation of Metals by Zinc," by J. Davies; "Researches on the Paraffins existing in Pennsylvania Petroleum," by T. Morgan; "Some Remarks on the Preceding Paper," by C. Schorlemmer.
—— Philosophical Club, 6.
—— Zoological, 4.

TO CORRESPONDENTS.

ERRATA.—Vol xxx., p. 261, 1st column, line 22, *for* "proportion," *read* "proposition;" line 23, *for* "fact," *read* "facts;" line 47, *for* (÷), *read* (:).

Dr. *Burghardt, Martin Murphy, and G. C. Stewart.*—Next week.

* Obtained the number of marks qualifying for the Scholarship.

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Professor Tennant's Lectures on Rocks and METALLIC MINERALS at King's College are given on Wednesday and Friday mornings from 9 to 10 o'clock, and on Thursday evenings from 8 to 9. The Lectures commenced Thursday, January 22nd, and will be continued to Easter.

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THE CHEMICAL NEWS.

VOL. XXX. No. 786.

THE CONFERENCE ON THE SEWAGE QUESTION.

ELSEWHERE we present our readers with a brief report of the conference on the sewage question, held under the auspices of the Society of Arts. We may congratulate the friends of sanitary reform on the improving prospects of that great national question. The meeting showed a more practical frame of mind, and a greater disposition to look at the matter in a common sense point of view, than has been displayed on any former occasion. There was less of that intolerant disposition which at one time led irrigationists to claim for their process the position of a sewage orthodoxy, outside of which is no salvation. The general feeling of the assembly was well expressed by Dr. Lyon Playfair when he declared that there were several processes known, all capable of giving excellent results, and that the choice in any particular case must depend upon local facilities. Mr. Hope, indeed, declared that, in the opinion of every competent man of science, sewage can only be properly purified by irrigation or filtration through soil. Without any wish to disparage Mr. Hope's military and engineering merits, we cannot accept him as the judge of scientific competence. What is "proper" purification is a matter of opinion. Sewage cannot be rendered absolutely pure and fit for domestic uses by any process practicable on a large scale. We must remember that no sanitary authority would for a moment recommend the drainage of cultivated lands as fit to be admitted into the water supply of a town. If, by proper purification, we mean rendering sewage colourless and transparent, free from all odour, incapable of becoming putrid, or of causing the development of sewage fungus, we must then declare that this can be and has been effected without irrigation.

The question of "standards" underwent a considerable amount of discussion. A member of the late Royal Rivers' Pollution Commission pleaded for some fixed rule to determine whether any particular refuse liquid was admissible into a stream or not, and advocated the adoption of the now celebrated recommendations of that no less celebrated Commission. In defending them against the charge of unnecessary rigour—which, by the way, is not so much their sin as inconsistency—he made the fatal admission that they would not exclude the filthy water of the Irwell! What more is wanting to complete their condemnation. Is not the Irwell notoriously fouler than those effluents from precipitation processes which it was hoped the "Recommendations," if adopted by the Legislature, would exclude? We hope that, when next a copy of the "Recommendations" is sent to any foreign chemist for his approval. it will be accompanied by a Winchester quart of Irwell water by way of illustration.

The majority of the speakers who entered upon this part of the question objected to a hard and fast rule, and preferred an elastic standard, so that every case might be judged upon its own merits, and that the law should be mild at first and be made gradually more stringent as public opinion becomes more enlightened. This is precisely what we have always advocated. We notice with much pleasure the suggestion of Mr. Evans, that the relative proportion of the refuse liquids to the streams should not be overlooked.

Mr. Smee's denunciation of the system of passing sewage over or through growing vegetation was vigorous in the extreme. The charges which he brings can easily be submitted to experimental verification. Meantime, it cannot be denied that several of them have the *a priori* appearance of probability. That vegetables nourished with sewage should putrefy more readily than others is far from unlikely. The same must be said concerning the statement that the milk of cows fed on sewage-grass was abnormally ready to enter into decomposition. Nor can we wonder if the roots of sewage-grass are coated with excrementitious matter which readily betrays its origin. We must point out that the Prussian commissioner, Lefeldt, found the grass from an irrigation field near Edinburgh saturated, for some inches, with "unassimilated fœcal matters." Mr. Smee thinks that irrigation, where adopted, should be preceded by some precipitation process. The attempt of Mr. Bailey Denton to refute Mr. Smee was eminently unsuccessful. The former gentleman (if we did not misunderstand him) contended that sewage matters would not cling to the roots and stems of grass, &c., if the soil were sufficiently porous—a plea which cannot be entertained for a moment. Nor is it much more logical to contend that, because a bull has been fed on sewage-grass, and, when slaughtered, shows no mark of disease, entozoic or otherwise, that therefore irrigation with untreated sewage is safe. Disease, in man or beast, is the result of a complication of causes. So long as one of these is wanting, the effect does not ensue. We could point to villages in Suffolk where the inhabitants obtain their water from road-side ponds contaminated with the drainage of manured fields and the oozings from farm-yards and cess-pools. The standard of health in such districts is fair; but let once the germs of any zymotic disease be introduced, and then, as the late Dr. Lankester remarked in a lecture at Stowmarket, the living will scarcely suffice to bury the dead.

It was satisfactory to observe that sewage was decidedly regarded by the meeting, not as a source of wealth to be held back while the market rises, but simply as a nuisance which must be abated, profitably if possible, but at all events abated. It is all very well to calculate the expense of treatment, and avoid any needless increase of municipal burdens; but, as one of the speakers pointedly observed, local authorities should also count the cost of neglect. We are by no means certain that the latter will prove the lighter. Persistence in polluting streams, until some self-sacrificing company offers a royalty for the honour of purifying their sewage, is a delusion which municipal authorities will do well to throw aside.

The tone taken by the conference will undoubtedly strengthen the hands of Government in compelling towns to adopt some remedial measures. But the attempt to dictate any one particular process, or to adopt the standards of the Royal Rivers' Pollution Commissioners, will meet with the most determined opposition.

EXPERIMENTAL RESEARCHES ON VEGETATION.

THE EMPLOYMENT OF VEGETATION TO ASCERTAIN AND DEFINE THE MOLECULAR STATE OF BODIES;

THE ANALYSIS OF VEGETABLE EARTH BY RATIONAL METHODS OF CULTURE.

By M. GEORGES VILLE.

SOME years ago, I called the attention of scientific men to some facts in vegetation of a new order, of which I was not able at the time to define the character with any amount of certainty, nor foresee all the results. More fortunate at this time, I believe I am able, in a measure, to assign to my experiments their true signification. We can employ vegetation to aid us in penetrating the molecular state of bodies, and analysing the vegetable earth by rational methods of cultivation. These are the two conclusions to which all my work has led me.

The thoughts that vegetation awakens in us are so removed from molecular and analytical chemistry that, in spite of myself, I feel a sort of diffidence in tabulating these conclusions. Convinced, however, of their accuracy, and desirous of answering the doubts which may arise from them, I will give the history of my observations in the order in which they were made. I will not deny that chance and intuition have had much to do with these discoveries; and I will not, therefore, have recourse to the artifice of a methodical statement drawn up after the research is finished, to enhance its merit and originality.

In researches founded on experiment, it frequently happens that facts cause us to give up our preconceived ideas, even to make us abandon the track that we were following. But it also happens that a happy accident opens to us a new field for work. After this period of doubt and uncertainty, where the unforeseen occupies the first place, there comes a time when we feel the ground firm under our feet, and a dominant idea inspires and directs us. From this time the experiments co-ordinate, and their results harmonise and point towards one common end.

Experiment then commences to be an instrument of discovery in our hands, conducting us, by a succession of doubts more and more diverse, to a new order of ideas, or, to make use of a hackneyed formula, causing us to pass from the known to that which yet remains unknown. Later, its *rôle* becomes more humble, and its office more subordinate. It is then when, determined on the general sense of phenomena, we ask experiment to produce its first proofs, in order to definitely complete the certainty and the degree of generality.

The explanation which follows will participate in these two characteristics; at first, indefinite and halting; later on, more concordant, more confidant, and affirmative. This change will mark the term of uncertainty inseparable from the novelty of the results, and will testify to the effort by which the mind enters at last into the possession of ideas true in themselves and carrying their own conviction.

A great master of the art of interrogating nature has written, in a celebrated preface, these remarkable lines:— "There are men who, to acquire a little more reputation, keep back a new fact that, perhaps, they have not had much merit in discovering, until they can astonish the world by a system as complete as it is new, and give a prodigious idea of their judgment and penetration. But they are justly punished for their ingratitude towards the source of all knowledge, and they fail in true love to science and to humanity, in finding the discovery of which they are so proud divulged by men whose natural ardour leads them to physical research, and who communicate freely to others all that is presented to them in their work. For myself, I find it absolutely impossible to produce a work on the subject of which I am treating which leaves nothing to desire."[*]

The authority of Priestley that I have just quoted is introduced at this time for my excuse and justification if the results that I now publish are found in any way incomplete or defective.

I.—Everyone knows now that phosphorus is one of the most essential agents of vegetable life. It is further known that it is by means of earthy or alkaline phosphates that it fulfils its most important functions. But phosphorus forms with oxygen, independently of phosphoric acid, two other acids less oxygenated, phosphorous acid and hypophosphorous acid. It would be interesting to know how far the salts formed by these last-mentioned acids might take the place of phosphates; or, in other words, to what degree an artificial soil formed of phosphite and hypophosphite of lime would be fertile. On this point, my experiments have never been doubtful: their answer has always been in the negative. In a soil of this nature, the seeds germinate, but the vegetation shows signs of weakness and poorness, and the death of the plant soon follows. It is so invariably, and appears fatal to plants grown under these conditions. I will give an example.

1861.—*Cultivation of Wheat.*[†]

Dry Product.	Phosphate of Lime.	Phosphite of Lime.	Hypophosphite of Lime.
	Grms.	Grms.	Grms.
Straw and roots ..	16·72	3·40	1·40
Grain	4·27	0·22	0·00
	20·99	3·62	1·40

One can easily form conjectures to explain the passivity of phosphite and hypophosphite of lime; but, instead of yielding to this temptation, I thought it more useful to inquire if results of the same kind could be produced with other compounds. Nitrite of potash, which corresponds to phosphite, experimented with for this purpose, shows an action still weaker than the nitrate. The functional incapacity of phosphites and hypophosphites ceases, then, to be an anomaly and an exception. It depends on a general law well worthy of being explained by the results which are manifested.

1861.—*Cultivation of Wheat.*

Dry Product.	o·110 grm. of Nitrogen in the state of	
	Nitrate of Potash.	Nitrite of Potash.
	Grms.	Grms.
Roots and straw ..	16·55	6·97
Grain	4·27	1·07
	20·82	8·04

1861.—*Cultivation of Buckwheat.*

Roots and straw ..	8·35	3·60
Grain	3·13	1·74
	11·48	5·34

1861.—*Cultivation of Wheat.*

Roots and straw ..	5·00	2·00

Is a certain degree of resemblance in the form, composition, and chemical properties of bodies, as the resemblance between phosphites and nitrites, indicative of corresponding or analogous functional capacities? To dissipate my doubts on this subject, it appeared to me that salts of ethylamine and methylamine, compared with ammoniacal salts, ought to offer unhoped-for resources. The nature of these remarkable substances is too well known for it to be necessary to describe them fully here. Ethylamine and methylamine are derived from ammonia

---

† The soil was of calcined sand, with the addition of o·110 grm. of nitrogen in the state of nitre, and all the minerals necessary to vegetation in the form of a multiple silicate of lime, potash, magnesia, and iron.

by the substitution of groups C_4H_5 and C_2H_3 for one equivalent of hydrogen, H. These two products possess, like ammonia, the most powerful basic properties. All leads us to think that in them nitrogen has preserved its original position with regard to the other elements. The following formulæ show more strikingly the close connection of these substances with ammonia :—

Ammonia.   Ethylamine.   Methylamine.

$$N\begin{cases}H\\H\\H\end{cases} \qquad N\begin{cases}H\\H\\C_4H_5\end{cases} \qquad N\begin{cases}H\\H\\C_2H_3\end{cases}$$
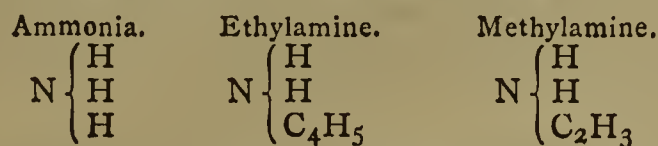
Like medals of different metals struck from the same die, these bases, though of a different elementary composition, are, nevertheless, of the same chemical type. Saturated with hydrochloric acid, and employed in a manner to represent the same quantity of nitrogen, all these exert exactly the same action on vegetation. The results are so similar as to be practically identical.

1862.—*Cultivation of Wheat.*
(Seed, 22 grains.)

Dry Product.	0·110 grm. of Nitrogen in the state of Chlorhydrate.		
	Ammonia.	Ethylamine.	Methylamine.
	Grms.	Grms.	Grms.
Roots and straw ..	14·66	13·76	15·20
Grain	2·71	2·49	2·74
	17·37	16·25	17·94

Same Experiment on Barley, 1862.

Roots and straw ..	8·77	9·45	8·20
Grain	3·08	2·66	3·22
	11·85	12·11	11·42

Same Experiment with Buckwheat, 1861.

Roots and straw ..	6·15	4·70	5·20
Grain	1·64	0·76	1·85
	7·79	5·46	7·05

The wish to generalise the results gave me the idea to try the same experiment on urea and ethyl-urea, which are derived one from the other, as ethylamine from ammonia.

Urea.   Ethyl-Urea.

$$N_2\begin{cases}H_2\\H_2\\C_2O_2\end{cases} \qquad N_2\begin{cases}H_2\\H\\C_4H_3\\C_2O_2\end{cases}$$
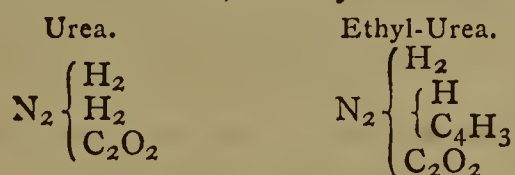
But here, to my great surprise, the effects on vegetation were quite different. Urea is a useful and active product; ethyl-urea, on the contrary, is neutral and passive. With the help of urea, vegetation is superb; as soon as ethyl-urea is substituted, its character changes, and it becomes as precarious and miserable as can be well imagined. How can these effects, so little like those of ethylamine and methylamine, be explained? Are we to see a simple anomaly, an accident, or an indication of a new and interesting order of facts to be defined and explained?

Ethyl-urea, we have said, is evolved from urea as ethylamine from ammonia, but urea itself is derived from ammonia; and if we compare the composition of these three products (urea, ethyl-urea, and ethylamine) with that of their common generator, ammonia, a great difference between ethylamine and ethyl-urea is revealed. In ethylamine, the ammoniacal type is preserved in all its integrity; one equivalent of hydrogen (one only) is expelled from the primitive compound, and replaced by the group C_4H_5. In ethyl-urea, the result on the molecular organisation of ammonia is more decided; for two equivalents of ammonia condensed into one become diatomic, three equivalents of hydrogen instead of two are displaced, and the void which thus results is filled by the groups C_2O_2, C_4H_4, which differ at the time in composition and the nature of their atomicity.

The examination of the four following formulæ renders these distinctions easier to follow :—

Ammonia. Ethylamine. Di-Ammonia. Urea. Ethyl-Urea

$$N\begin{cases}H\\H\\H\end{cases} \; N\begin{cases}H\\H\\C_4H_5\end{cases} \; N_2\begin{cases}H_2\\H_2\\H_2\end{cases} \; N_2\begin{cases}H\\H\\C_2O_2\end{cases} \; N_2\begin{cases}H\\H\\C_4H_5\\C_2O_2\end{cases}$$
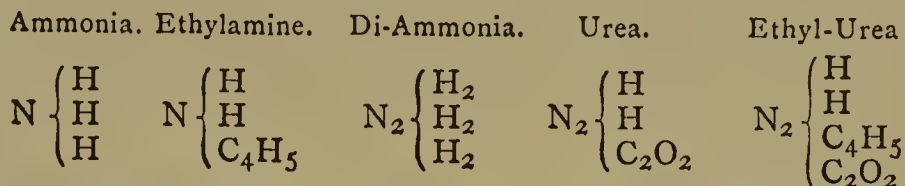
Brought to the composition of ammonia, and making allowance for atomicity, we see that urea corresponds to ethylamine, whilst ethyl-urea places itself between ethylamine and di-ethylamine.

Ethylamine.   Ethyl-Urea.   Di-Ethylamine.

$$N\begin{cases}H\\H\\C_4H_5\end{cases} \qquad N_2\begin{cases}H\\H\\C_4H_5\\C_2O_2\end{cases} \qquad N_2\begin{cases}H_2\\C_4H_5\\H_5\\C_4\end{cases}$$
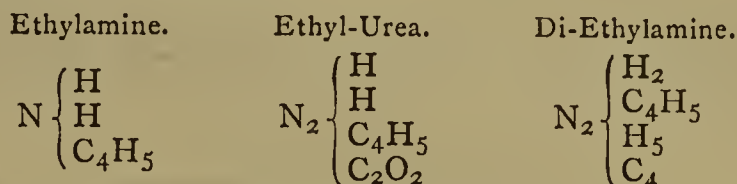
In ethyl-urea, the substitution is pushed farther than in ethylamine. If the passivity of ethyl-urea is due to this cause, all derivatives from ammonia in which the second equivalent of hydrogen is replaced ought to become, by reason of that, inactive with regard to vegetation ; and, if this conjecture be true, then it will be demonstrated that the close connection which manifests itself between the molecular type, the composition, chemical characters, and functional capacities of bodies, ceases at once, as far as their capacities when they form part of living beings, whilst their other properties remain.

If vegetation is influenced to this extent by changes of the most exquisite delicacy carried into the composition of agents with which they are put in contact, it results that its organisation offers us, in reality, a new means of exploring the order of position between the primitive elements of matter, and of aiding us in defining them.

Thanks to the valuable assistance of M. Hofmann, I have been able to submit this conjecture to the test of positive verification.

I have said on several occasions that ethylamine differs from ammonia by the substitution of group C_4H_5 for 1 equivalent of hydrogen. But the substitution may be pushed further. With regard to chloride of ammonium, for example, we can realise chloride of tetrethyl-ammonium, in which the total amount of hydrogen belonging to the initial type (ammonium, NH_4) is replaced by the group C_4H_5, equivalent for equivalent.

	Chloride	
Of Ammonium.		Of Tetrethyl-Ammonium.
$N\begin{cases}H\\H\\H\\H\end{cases}Cl$		$N\begin{cases}C_4H_5\\C_4H_5\\C_4H_5\\C_4H_5\end{cases}Cl$
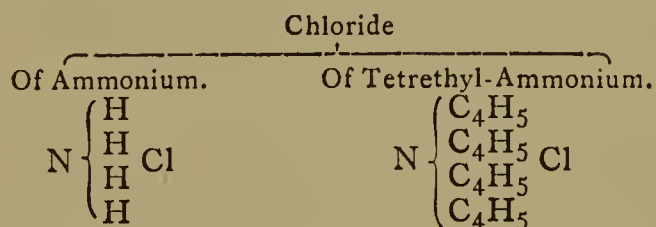
In the second compound is found essentially the type of the first. The two groups possess the same fundamental properties. However, in regard to vegetation, a radical opposition is revealed between them. Chloride of ammonium assimilates with vegetation; its action is most favourable ; it soon causes the growth of cereals. Chloride of tetrethyl-ammonium, on the contrary, does not produce any appreciable effect. In this form, nitrogen, usually active in the highest degree, becomes absolutely inert. This may be judged of by a comparison of the two following results :—

1862.- *Cultivation of Buckwheat.*

Dry Product.	Of Ammonium.	0·110 grm. of Nitrogen in the state of Chloride Of Tetrethyl-Ammonium.
	Grms.	Grm.
Roots and straw ..	7·51	0·79
124 seeds	2·40	0·00
	9·91	0·79

I should have considered it a great privilege to have been able to experiment on chloride of diethylamine, but, not succeeding in procuring this product with sufficient guarantee of its purity, I have had recourse to dimethyl-oxamide and diethyl-oxamide, the composition of which, brought to that of ammonium, corresponds exactly to that of diethylamine.

Ammonia.	Diethylamine.	Oxamide.	Diethyl-Oxamide
$N \begin{cases} H \\ H \\ H \end{cases}$	$N \begin{cases} H \\ C_4H_5 \\ C_4H_5 \end{cases}$	$N_2 \begin{cases} H_2 \\ H_2 \\ C_4O_4 \end{cases}$	$N_2 \begin{cases} H_2 \\ C_4H_3 \\ C_4H_3 \\ C_4O_4 \end{cases}$
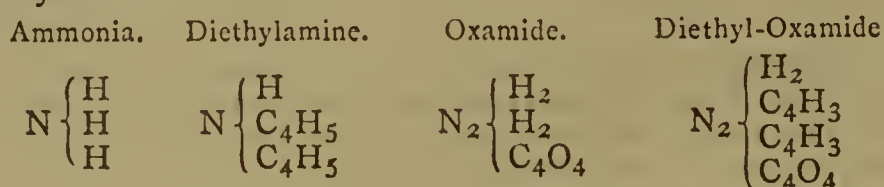
Oxamide favours vegetation; diethyl-oxamide is absolutely inert, in the same degree as chloride of tetrethylammonium itself.

Cultivation of Buckwheat.

0·110 grm. of Nitrogen in the state of

Dry Product.	Oxamide.	Dimethyl-Oxamide.	Diethyl-Oxamide.
	Grms.	Grm.	Grm.
Roots and straw ..	5·00	0·62	0·25
Seeds	1·50	0·00	0·00
	6·50	0·62	0·25

How curious and unexpected are these effects! Who would have predicted *à priori* the inertia of ethyl-urea, of dimethyl-oxamide, of diethyl-oxamide, of chloride of tetrethyl-ammonium, in face of the contrary properties of chloride of ammonium, of urea, of oxamide, and the salts of ethyl and of methylamine? Who would have ventured to attribute the functional incapacity of the products of the first series to a difference in the degree attained by the substitution?

Twenty-two grains of wheat, cultivated with 0·110 grm. of nitrogen in the state of urea, have produced 18 grms. of harvest. The same quantity of nitrogen, under the form of ethyl-urea, has only produced 2·67 grms. Who would have thought that a day would come when vegetation would permit us to follow with so much accuracy the progression of substitutions effected in the interior of a molecular system of which the original type remains? As to the hope that I have just expressed, to found on these experiments on cultivation a new mode of investigation to aid us in defining the true molecular state of bodies, it only remains for me to show, by an example, that I do not exaggerate the importance and utility of them.

(To be continued.)

ON BASIC CALCIUM CHLORIDE.*

By HARRY GRIMSHAW, F.C.S.

WHEN a strong solution of calcium chloride is boiled with calcium hydrate, the solution filtered, and allowed to cool, a salt separates out in long, slender, needle-shaped crystals. This salt is called in Gmelin's "Handbook," hydrated chloride of calcium and lime, or hydrated tetrahydrochlorate of lime, and, according to him, has been noticed by Bucholtz and Trommsdorf and by Berthollet, and analysed by H. Rose, who found the formula 3CaO, CaCl+16Aq, or in present notation $3CaO,CaCl_2+16H_2O$. This is not a very simple or intelligible formula, and moreover the percentage of water found, which was 49·084, is considerably lower than that required by the formula, namely, 50·793. The salt was therefore prepared and analysed as follows:—

The solution of calcium chloride was prepared by dissolving, by heat, pure white marble in moderately concentrated hydrochloric acid until saturated. This was boiled with an excess of milk of lime for about an hour, filtered whilst hot and allowed to cool. The salt sepa-

rated out, on standing, in slender, white, needle-shaped crystals, generally from one-half to an inch in length. They were sometimes obtained of not more than a quarter of an inch in length, and almost transparent, the separation not taking place until the solution was agitated. The composition of the crystals was in all cases the same, and was not affected by the length of time they were allowed to remain in contact with the liquid. The crystals, dried as quickly as possible between blotting-paper, on analysis gave the following results:—

(*a*) 0·677 grm. gave 0·273 grm. CaO.
    0·442 ,, ,, 0·228 ,, AgCl and 0·0012 Ag.
    0·307 ,, lost on heating 0·152 grm.
(*b*) 0·359 ,, gave 0·144 grm. CaO.
    0·794 ,, ,, 0·2045 ,, AgCl and 0·0245 Ag.
    1·052 ,, lost on heating 0·52 grm.

	Calculated for $CaO,CaOHCl+7H_2O.$	Found		Calculated for $3CaO,CaCl_2+16H_2O$
		(*a*)	(*b*)	
Ca ..	29·144 ..	28·80	28·77	.. 28·22
Cl ..	12·932 ..	12·86	12·794	.. 12·522
O ..	5·829 ..	—	—	.. 8·465
OH ..	6·193 ..	—	—	.. —
H_2O ..	45·901 ..	—	—	.. —
Loss on heating }	49·179 ..	49·40	49·47	(H_2O)50·793
	100·000			100·000

The constitution of the salt is therefore expressed by the formula—

$$O \begin{cases} CaOH \\ CaCl \end{cases} +7H_2O.$$
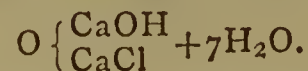
On heating two molecules of the salt decomposed, forming $3CaO+CaCl_2+15H_2O$. The difference of the proportion of the constituents according to the above formula, and according to that assigned by Rose, is therefore that corresponding to one atom of water more or less. As the amount of water is nearly 50 per cent of the whole, this constituent will exhibit the greatest difference, namely, 1·514. Accordingly, the numbers above will be found to agree with the formula—

$$O \begin{cases} CaOH \\ CaCl \end{cases} +7H_2O,$$
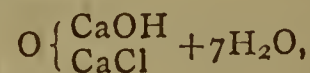
which loses on heating 49·179 per cent. The number found by Rose (49·084) agrees very nearly.

The salt is perfectly stable for any length of time if kept out of contact with the air. It may be also kept unaltered in the mother-liquor for some time. In the air it decomposes, absorbing carbonic acid and water. Over sulphuric acid *in vacuo* or in air, or over quicklime, it parts with a portion of its water of crystallisation. Both these circumstances interfere with the exact drying of the salt.

With water, it decomposes into calcium hydrate and calcium chloride—

$$2 \left[O \begin{cases} CaOH \\ CaCl \end{cases} \right] +2H_2O = 3Ca(OH)_2+CaCl_2.$$
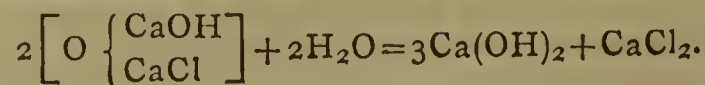
By the substitution of hydrobromic for the hydrochloric acid in the preparation of the salt, I expect to obtain a corresponding bromine compound.

Action of Heat upon Ordinary Aldehyd.—M. Berthelot.—The following experiment throws a new light upon the relations of carbonic oxide to common aldehyd. Aldehyd was evaporated in hydrogen so as to yield a gas formed of 5 vols. of hydrogen and 2 of aldehyd, and this mixture was heated to dull redness for half-an-hour. At the end of that time it was found on analysis to have been decomposed into carbonic oxide and formene.—*Comptes Rendus*, No. 20.

CONFERENCE ON THE SEWAGE QUESTION.

ON the 10th inst. a conference of gentlemen interested in the sewage question was held in the Hall of the Society of Arts under the presidency of Dr. Lyon Playfair, C.B., M.P., F.R.S. Among those present we observed Sir R. Torrens, Sir J. Murray, Sir Joseph Heron, Mr. A. Smee, Dr. Stenhouse, Major-General Scott, Prof. Wanklyn, Messrs. W. C. Sillar, Chalmers Morton, C. Rawson, W. Hope, Bailey Denton, Baldwin Latham, C. Elcock, Evans, Fowler, &c., &c. A circular invitation had been issued to the promoters of the principal sewage processes to send in a condensed exposition of their methods. These, to abridge the proceedings, had been printed, and were distributed to all present. The subject was divided into three heads, namely :—The existence of the evil and the necessity for a remedy ; the question of separating fæcal matters, manufacturing refuse, &c., from the rain-fall ; and lastly, the best ways of treating water-borne sewage. Each of these sections was discussed *seriatim*, no speaker being allowed to exceed ten minutes.

Mr. CHALMERS MORTON urged the necessity of fixing standards for refuse liquids discharged into rivers. He favoured the " Recommendations " of the late Rivers' Pollution Commission, of which he had been a member, and by way of proving that these were lenient, he stated —if we did not misapprehend him—that they would admit such water as that of the river Irwell.—(Ironical applause).

Major-General SCOTT concurred with Mr. Morton as to the necessity of standards, but thought it important not to outrun public opinion by too great stringency at the outset. He would compel towns, at any rate, to free their sewage from all solids and suspended matters before turning it into the rivers.

Mr. THOM, as one of the greatest river polluters in the kingdom, pointed out that manufacturers themselves would be benefitted by sensible legislation. The uncertainty of the law kept them at present in a state of uneasiness. He had at one time diverted the foul waters from his print-works from entering the river, but had received notice from his landlord that by so doing he was breaking one of the covenants of his lease and endangering his (the landlord's) rights. Many manufacturers were willing to purify their waste waters, if permitted, and protected from negligent neighbours.—(General applause).

Sir R. TORRENS described the pollution of the rivers in Devon by water from the mines, and explained that there was no legal redress except it could be proved that the fish were actually poisoned. He did not think that any very severe law could be worked in the present state of public opinion, and advocated moderate measures.

Sir J. MURRAY stated that the river Sherborne, near Coventry, had been much improved recently.

Lieut.-Col. A. JONES advocated the separation of manufacturing from domestic refuse.

Major-Gen. SENGE raised the question how the pollution of rivers had become so universal ?

Mr. EVANS considered manufacturing refuse easier to deal with than fæcal matter. He thought that the standards adopted should be mild and elastic, and recommended that the quantity, as well as the quality of refuse-water poured into any stream should be taken into consideration.

Sir JOSEPH HERON declared that the Irwell was purer on leaving Manchester than when it entered the city. He objected to water-closets, which had been forced upon the public by unwise legislation.

A motion recognising the necessity for special legislation on the treatment of sewage and refuse was moved by Sir Joseph Heron, seconded by Sir J. Murray, and carried unanimously.

In considering the second section of the subject, Capt. LIERNUR gave an account of his system, which dispenses with water-carriage. He pronounced irrigation unsuccessful, and reminded the meeting that sanitary works, which threw heavier burdens upon the poor, might sometimes have the very opposite effects to those intended.

Rev. Mr. MOULE condemned the sewage system, and pointed out the great additional expense involved in the extra supply of water it demands.

Prof. J. A. WANKLYN pointed out the difficulty of determining with the needful accuracy such small amounts of " organic nitrogen " as 0·003—a quantity far within the limit of experimental error. He would consider it sufficient if refuse waters were rendered colourless and free from suspended matter.

Mr. CHALMERS MORTON rose in some excitement, and amidst cries of " Question !" and marks of disapprobation objected to the remarks of the last speaker, which, he thought, had better have been laid before the Chemical Society.

Prof. WANKLYN replied that his views had been laid before the Chemical Society six years ago, and had not been controverted.

The CHAIRMAN here stated that had he considered Mr. Wanklyn out of order he would have immediately interposed.

Mr. BALDWIN LATHAM pointed out the practical difficulty of separating manufacturing and domestic refuse. He defended water-closets and condemned the " pail-systems" of certain northern towns in strong language. He would separate the rainfall from the sewage.

Mr. C. J. WARHÆ asked why manufacturers alone should be blamed ? Agriculturists and land-owners often pollute streams by the drainage from farm-yards, dung-hills, and manured fields.

Mr. C. ELCOCK pronounced water-closets most ingenious machines for poisoning, and defended the pail-system.

Mr. Alderman TAYLOR (Rochdale) likewise defended the pail-system, and made an attack upon the landed interest, whose greediness, he said, rendered irrigation costly.

The third division of the subject being now introduced, Mr. C. RAWSON pointed out that every good sewage-system should fulfil four conditions. It should produce a safe effluent ; it should create no nuisance in its operations ; it should use no article or process calculated to injure the manurical value of the sewage matters ; and it should be economical in working. Independent testimony, he contended, proved that all these conditions were fulfilled by the A B C system.

Mr. JONES (Ealing) urged the claims of the old lime-process.

Col. HOPE, V.C. thought that in the opinion of competent men of science, sewage could be properly purified only by irrigation or passage through earth.

Mr. A. M. FOWLER spoke of the difficulty of manufacturers treating their refuse separately. As a totally disinterested party he corroborated Mr. Rawson's remarks on the A B C process, stating that he found fishes survived in the A B C effluent longer than in Leeds town water.

Mr. W. C. SILLAR, in a short but effective speech, which was loudly applauded, pointed out the costs of sanitary neglect.

Mr. A. SMEE denounced the filthiness of grass grown on irrigation farms. He declared that vegetables manured with sewage putrefy more readily than those not so treated and that the milk of cows fed on sewage grass enters very readily into decomposition. He cautioned the public against watercresses grown in sewage.

Rev. Mr. CLUTTERBUCK urged the necessity of separating rain-fall from sewage. He thought the A B C system difficult of execution.

Mr. HALL declared the sewage question merely one branch of a wider subject—the removal of all offensive matter from towns. He pointed out the offensive character of " dust-bins " which contain, not merely ashes and house sweepings, but a variety of putrescible matter.

Mr. MORGAN (Lodge Farm, Barking) spoke of the good results he had obtained from irrigation with the effluent from the Phosphate Company's process. Had Mr. Hope's

scheme for dealing with the sewage of North London been carried out the results would have been ruinous.

Mr. BAILEY DENTON contended that if land were made sufficiently porous fæcal matters would not attach themselves to the roots and stems of grass.

The Conference then broke up, after a vote of thanks to the President.

NOTICES OF BOOKS.

Pharmacography; a History of the Principal Drugs of Vegetable Origin met with in Great Britain and British India. By F. A. FLUCKIGER and D. HANBURY. London : Macmillan and Co.

THIS book takes a very well-defined position, and supplies what has hitherto been a desideratum in the pharmaceutical literature of England. The authors have not included in their programme either pharmacy—in the strictest sense of the word—or therapeutics. Each drug is headed by its Latin name, followed by such synonyms as may be required for perfect identification, together with its English, French, and German designation. The botanical origin of the substance is next examined, and the locality of its growth or production is given, but as a rule no attempt has been made to furnish botanical descriptions of the plants in question. The authors then, under the head of *history*, trace the introduction of each substance into medicine, "and to bring forward other points in connection therewith," not hitherto much noticed in any recent work. Upon this follow the formation, secretion, or method of collection of drugs, and a description of its characteristics and microscopic structure. Next follows the chemical composition, under which head, however, it has been no part of the authors' plan to supersede reference to standard chemical works. Further headings touch on production and commerce, adulterations, and substitutes.

An undertaking so difficult, extensive, and complicated involves no small amount of labour and research. These the authors have evidently not spared. The book bears the impress of thoroughness and accuracy, and supplies, to the best of our judgment, much valuable information for which the student might elsewhere search long and vainly. To medical men, pharmaceutical chemists, and drug merchants it will prove an inestimable work of reference.

On the Use of Strychnine in Epilepsy and Kindred Nervous Affections. By WALTER TYRRELL, M.R.C.S. London : R. Hardwicke.

THIS pamphlet, as the title alone intimates, is strictly medical in its character. The author gives a brief account of the seat, cause, and treatment of epilepsy, and appends a number of cases. We have no doubt that it will be found interesting and suggestive by his professional brethren.

Introductory Address at St. Georges' Hospital, October 1, 1874, on the Art and Science of Medicine. By W. HOWSHIP DICKINSON. London : Longmans, Green, and Co.

THAT this address should have been published, as we are told on the title page, at the request of the resident medical officers and students of the hospital, is not surprising, for it contains words of wisdom not a few. Of pathology the author says :—" Like the age it is becoming materialist. Functional or unsubstantial diseases are flitting before the microscope like ghosts at sunrise. Nervous disorders, the most evasive of all, are becoming tangible. Insanity is no longer a disease of the mind, but of the brain ; the changes are none the less real

because they are small and numerous. One man may be battered with a bludgeon, another stung to death by pismires, and the injury be as material in one case as the other." We will make no further extracts, but merely say that these forty pages, quaint, quiet, but thought-exciting, might be advantageously read by every man of science.

CORRESPONDENCE.

FERROUS SULPHIDE IN CHAR.

To the Editor of the Chemical News.

SIR,—I have little time to devote to this question, yet Mr. Smith's letter in the CHEMICAL NEWS vol. xxx., p. 261, exacts a few words.

I think Mr. Smith will admit, that should the sulphide in the char be admitted as *ferrous*, its constitution will be that of a *ferrous monosulphide*, FeS, not ferrous disulphide, FeS$_2$; and that when FeS is acted upon with *dilute* HCl, the whole of the sulphur will be cast off as H$_2$S conformably with the reactions indicated in the formula—

$$FeS + 2HCl = FeCl_2 + H_2S.$$
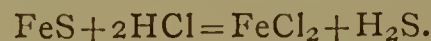
If, on the other hand, strong HCl should be employed, some of the S would be set free, owing to the influence of various agencies, in which case the sulphur so produced would necessarily be recovered by exhausting the dried mass with CS$_2$.

The adoption of the latter course in the analysis of chars, not only complicates the work, but is, in my opinion, unchemical and leads to error.

Need I tell Mr. Smith that I do not follow it, and that unless the char be treated *ab initio* with *strong* HCl, no sulphur will remain for extraction with CS$_2$.

In example 2 of Mr. Smith's letter, a grave error is stated. If the calcic sulphide were heated to the *melting-point* in the process of re-burning the char, I would cede that Mr. Smith is right ; but it is not so heated, and the energy of the calcium in the absence of fusion heat, or menstruum of any kind, binds the sulphur to itself.

In all good faith, I advise Mr. Smith to reconsider his work, and see if he really does not produce the very FeS he speaks of by his method of operations.

I am inclined to think he does, just as the free sulphur he speaks of is the result of the action of an unsuitable reagent.

MARTIN MURPHY.

The Liverpool College of Chemistry,
December 5, 1874.

IRON IN CHAR.

To the Editor of the Chemical News.

SIR,—I observe in the CHEMICAL NEWS a communication from the pen of Mr. R. Frazer Smith, F.C.S., upon the presence of iron in animal charcoal, in which he modestly *advocates* the advantages which are to be derived from the use of the " classical " permanganate of potassium process.

Allow me to inform your correspondent that I had the honour of advocating this very same thing, some few months ago, in a communication which I contributed to your periodical upon the " Analysis of Animal Charcoal," and which was afterwards copied into the *Sugar Cane,* and subsequently appeared in abstract in the *Journal of the Chemical Society.* In all of these my paper reads thus :—" The oxide of iron, which is very constant in amount in new and old char, is best determined volumetrically by dilate standard solution of the potassic-anhydro-chromate (Penny's process) ; *or, better, by dilute standard solutions of the potassic permanganate,* using

o·5 grm. $KMnO_4$ in 1 litre distilled water," &c. Now, I have used the process for nearly three years in estimating this constituent in many samples of char which I have had occasion to analyse, and yet, after having advocated its great advantages publicly, through your columns, we find your correspondent, Mr. Smith, *only now* advocating processes for the analysis of char which I have myself done *long ago.* Again allow me to say that the iron in char does not exist as $Fe_2 O_3$, as your correspondent's analysis would lead them to believe, but as FeO, *vide* Crookes's "Manufacture of Beet Sugar," page 165. "The iron is always in a state of *protoxide*, faint traces of peroxide excepted," &c. More than that, allow me to inform your correspondent that he has never yet estimated *all* the moisture in char, if he only dries his sample in water-bath.

In my paper, I recently advocated that *all* the moisture *was not* expelled at water-bath heat, and that it required a temperature varying from 160—180° C. to effect all the expulsion of the moisture, and, further, no organic matter is driven off, nor need be. And must I, of necessity, quote Fresenius, to impress these facts strongly upon the minds of your readers?—"Analysis of Bone-Black (General Process).—Dry 2—3 grms. at 160—180° C. The loss in weight is *moisture.*"* Here is a statement which, word for word, confirms my views upon this point, not new, but made *long ago* by the highest authority upon analytical chemistry. It would seem as if Mr. Smith had never read Fresenius nor Crookes upon the "Manufacture of Beet Sugar," and many other authorities on bone-char. In conclusion, I must say that I feel highly indebted to Mr. Martin Murphy, of Liverpool, for coming forward, and "liberalising" my views upon the chemistry of this substance. That gentleman will perhaps accept my best thanks in return.—I am, &c.,

G. C. STEWART, F.C.S.

Greenock, Nov. 30, 1874.

DOUBTFUL MINERALS.

To the Editor of the Chemical News.

SIR,—I think I have found out the source of T. A. R.'s difficulties with respect to his confusion in the names of minerals. To quote your correspondent's words in the CHEMICAL NEWS, vol. xxx., p. 238, he says :—"I think I have analysed every mineralogical treatise in the English language, from Jeffries, of 1751, to the present time, resolutely posting my ledger all the while." T. A. R. seems to forget that there are other languages besides English, and might have saved himself all this trouble by studying German works on the subject. However distinguished we may be in geology, in mineralogy we may be truly said to be only in our infancy, and immeasurably behind Germany.

In reply to some of the questions stated by T. A. R., I may say that the Beaumontite of Jackson is no definite mineral, and, therefore, cannot be said to exist. The Herrerite of Herrara, also, does not exist, unless the collection in the British Museum can produce a specimen. Volborthite has never yet been properly analysed, and is no doubt very nearly related to Kalkvolborthite. The latter name should be spelt with the letter "v" after the syllable "kalk, and not with the double "o," as it has several times been erroneously printed; "kalk" is the German word for calcium oxide, and, as Kalkvolborthite contains from 12·28 to 17·40 per cent of this oxide, the name is very appropriate. The Polyhalite of Stromeyer, and that of Berthier, are identical. Two analyses were made by MM. Dexter and Jenzsch, of the *very same specimen* analysed by Berthier—one piece having a grey colour, the other light red. It will be seen at once, from the results given below, that Berthier was entirely wrong, and Stromeyer right. Hence, only one Polyhalite exists.

* Fresenius's "Quantitative Analysis," 4 ed., 1865, p. 711.

	Stromeyer.	Polyhalite de Vic.		Berthier.	
		Dexter (Grey).	Jenzsch (Red).	1.	2.
$CaSO_4$ ..	44·74	44·72	44·11	40·0	52·2
$MgSO_4$ ..	20·03	19·08	19·78	17·6	2·5
K_2SO_4 ..	27·70	27·77	25·87	—	—
Na_2SO_4..	—	—	1·69	29·4	21·6
NaCl ..	0·19	0·44	0·24	0·7	18·9
Fe_2O_3 ..	0·34	0·59	1·01	4·3	5·0
H_2O ..	5·95	7·40	6·16	8·0	—
	98·95	100·00	99·38	100·0	100·2

Stibiconite, Stibiconise, and Stiblite are the same thing; the proper name for the mineral being Stiblite. Stibium, Stibnite, and Stibine are also the same thing; the proper name being Antimonite. Stilbite is not an Antimony mineral at all, and is known to modern mineralogists as a well-defined member of the Zeolite group. As to Stillolite, no such name is known to modern mineralogists.

Hoping your correspondent's mind will at last be set at rest,—I am, &c.,

CHARLES A. BURGHARDT, Ph.D.

The Owens College, Manchester,
    December 7, 1874.

THE CONSTITUTION OF MUREXIDE.

To the Editor of the Chemical News.

SIR,—With a desire to publish a long-prepared study of urea and ureide derivatives, I may be allowed to highly compliment Mr. Reoch on his chivalrous attempt to grapple with one of the darkest problems of organic chemistry. The hesitation on my part has arisen from an intense dissatisfaction with a very laboured effort to determine the constitution of murexide.

With a strong desire to share the view of Liebig, from which I cannot divest myself, I have, nevertheless, been compelled *pro tem.* to see things more after the manner of Prout. On either view, it does seem that murexide is a generic body, whose non-determination is a reproach to chemistry. The easy interchangeability of the mesoxyl and tartronyl radicals, and the great probability that two atoms of tartronyl ($C_6H_1O_6$) are necessary for the production of murexide, seem to suggest the possibility that a picric phenyl radical may be a result of their dedoublement or condensation; and hence would follow that we may have nitrophenyl-, cresyl-, and naphthyl-murexide. And while these have, in great measure, the peculiar dyeing properties of the actual ureide, there is also the same difficulty in isolating their hypothetical free acids.

I quite disagree with Mr. Reoch's estimate of the modern methods of research. If, for instance, two bodies − 2HO give a third body, and if the constitution of the two bodies be approximatively known, and the generic process of eliminating 2HO be well understood, then we can do much towards an *a priori* projection of the unknown constitution; after which the actual and ultimate analysis will have a double value. It is somewhat in this way that our great chemists have regarded murexide as a C_{16} body (C_8). Mr. Reoch seems to prefer that we should invert this order, and commence with analysis; and hence his determination that the body contains C_{20}, &c. His more recent analysis may be better than theirs, and conjoined with their methods might lead to corrections which might explain the confusion and barrenness of all preceding efforts; but, standing by itself and without those methods, it is simply blank knowledge.

The true purpurate, murexide, is prepared from varied tartronyl ureides; the iso-purpurates from cyanides and picric acid or its analogues; the meta-purpurates from cyanides and dinitro compounds. It is further said that the iso-purpurate of ammonia is indistinguishable from murexide, and may be used for similar dyeing purposes.

With the earnest desire that further efforts may be made to resolve this intricate and useful problem,—I am, &c.,

S. E. PHILLIPS.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 20, November 16, 1874.

The Carbonyls, a New Class of Organic Compounds; and on the True Function of Ordinary Camphor.—M. Berthelot.—The carbonyls are a subdivision of the aldehyds, and comprise three well-defined bodies—ordinary camphor, oxide of allylen, or dimethylen-carbonyl and diphenylen-carbonyl, otherwise known as diphenylen-aceton. The composition of these bodies is—

Oxide of allylen, $C_6H_4O_2$ or $(C_2H_2,C_2H_2)C_2O_2$.
Diphenylen-carbonyl, $C_{26}H_8O_2$ or $(C_{12}H_4,C_{12}H_4)C_2O_2$.
Camphor, $C_{20}H_{16}O_2$ or $(C_{10}H_8,C_{10}H_8)C_2O_2$.

Suberon, $C_{14}H_{12}O_2$, probably possesses a parallel constitution. These bodies may be regarded as types of homologous series, and of a multitude of other compounds, having the same characteristic reactions. They are able to fix hydrogen, and to become converted into alcohols, and reciprocally the alcohols thus produced reproduce carbonyls by the loss of hydrogen. This general reaction the author proposes as the characteristic of the aldehyds, including the primary aldehyds, the secondary, or acetons, and the mixed aldehyds, among which are the quinones. The carbonyls may also be formed directly or indirectly by the substitution of oxygen for hydrogen in equal equivalents. The carbonyls are in themselves incomplete bodies. The fixation of the elements of water changes them into monobasic acids, and by the fixation of six equivalents of oxygen they may be transformed into bibasic acids. Camphor is distinguished from the true aldehyds by the fact that its direct oxidation does not furnish a monobasic acid comparable to the acetic. From the acetones it is distinguished by the circumstance that its oxidation yields a single bibasic acid without becoming split up into two distinct acids.

Electric Influence.—M. P. Volpicelli.—This paper requires several illustrations.

Action of an Electro-Magnet on the Spectra of Rarefied Gases Traversed by Electric Discharges.—M. J. Chautard.—This paper treats of the action which powerful magnets produce in the spectra of rarefied gases traversed by the discharge of an induction coil or of a Holtz machine. These spectra, characteristic of the matter through which the spark passes, offer, under the influence of the magnet, peculiarities very striking and special as regards number, position, intervals, and the degree of fineness of their lines. The experiments have as yet been confined to the spectra of the non-metallic bodies, taking for types the elements pointed out by M. G. Salet in the important research which he has published on this subject. Each body was enclosed in a Geissler's tube, having one part contracted and almost inear, which was placed between the poles of an electro-magnet, and at a small distance from the slit of a spectroscope. The divisions of the micrometer, previously marked upon the Frauenhofer lines, enables us immediately to convert the corresponding colours of the spectrum into the lengths of undulators. Finally, another Geissler tube quite analogous to the former, placed in view of the small reflecting prism, and outside the action of the magnet, gave a second spectrum in juxtaposition to the first so as to serve for comparison. A spark was then passed through

both tubes, and the perfect agreement of the lines given by each spectrum was ascertained. This agreement ceases the moment that the magnet is set in action. Whilst one of the spectra preserves its primitive character, that yielded by the gaseous matter exposed to the influence of the magnet undergoes remarkable changes, which in case of each body present new appearances, according as the intensity and the direction of the current, and the distance of the magnet. The bodies experimented upon are hydrogen, chlorine, bromine, iodine, oxygen, sulphur, selenium, and nitrogen. The light of selenium and of sulphur under the influence of the magnet is notably diminished in intensity, so that the spectrum, very feeble at first, disappears after the lapse of a few instants. Chlorine and bromine are characterised by an increase of lustre, and by the development of fine, brilliant, numerous lines, especially in the green, the appearance or disappearance of which, on turning the interrupter, produces a perfectly magical effect. These phenomena may have a certain importance, both as regards celestial spectroscopy, and as regards the obscure relations of magnetism and light.

Note on Magnetism, and on a New " Exploseur." —M. Trève.—The author describes an electro-magnetic arrangement for exploding mines, &c., at great distances, and used during the siege of Paris.

Manufacture of Paper from Gombo, and on the Industrial Uses of this Plant.—M. Ed. Landrin.—Gombo (*Hibiscus esculentus*) is a mulvaceous plant, growing in Syria and Egypt, where it is cultivated for the sake of its fruit. The fibre is prepared for paper-making by means of special machinery in a current of water, without any chemical treatment. The paper is very beautiful and strong, and may compete with the finest papers made from pure rags.

Insalubrity of the Seine in August, September, and October, 1874.—M. Boudet.—The author gives a table of the amount of oxygen dissolved in 1 litre of Seine water at a number of places. The quantity varies from 10·42 c.c. at Rouen to 1·02 at La Briche, and 1·05 at Epinay.

Method Employed for Discovering the Most Suitable Substance for Combatting the Phylloxera at the Viticultural Station of Cognac.—M. Max Cornu.

Effects of the First Cold on Phylloxerised Vines in the District of Cognac.—M. Maurice Girard.

On Fluoren.—M. Ph. Barbier.—The author connects fluoren to phenanthren and diphenyl. He has discovered a fluorenic alcohol, $C_{26}H_{10}O$.

Bulletin de la Societe Francaise de Photographie, No 5, 1874.

At the meeting of the Society, May 1, M. Duboscq stated in a letter addressed to the President that as early as 1853 he made microscopic projections, considerably enlarged, and that by a combination of his apparatus he was able either to superpose the image of a micrometer upon the photograph, or to substitute rapidly the one for the other.

M. Dumas, President of the Commission nominated by the Academy of Sciences to prepare and examine the most exact means of observing the transit of Venus, presented to the Society a collection of memoirs, reports, and documents on this subject. This volume is a convincing proof of the important part which photography is destined to play in this great astronomical question, and of the services which it will render to all the sciences of observation. Particular mention is due to a memoir by M. Cornu on the photographic achromatism of achromatic telescopes for direct-vision by the simple removal of the two lenses which form the objective.

A variety of communications had been received on the application of photography to the observation of the transit of Venus. Ch. Zenger substitutes a concave mirror for the ordinary object-glass, a method previously, but unsuccessfully, used by Woolcott, Beard, and Secchi

Zenger has succeeded in obtaining proofs of the moon and the sun, which have been brought to the enormous size of 110 English inches.

In connection with the presentation of a number of beautiful maps by the General Direction of Geographic and Geodesic Works of Portugal, it was mentioned that M. Rodriguez, the able organiser of the service, had obtained excellent results by his process.

Attention was drawn to No. 22 of the *Memorial de l'Officier du Genie*, containing an interesting memoir by Captain Javary on the use of photography for taking plans. This paper contains valuable instructions for those who wish to apply photography to the military art and to surveying.

In the same paper Captain de la Noe treats on the advantages of ferrocyanide of iron paper for the rapid multiplication of plans.

M. Castellani gives, in the *Revista Photografica*, an original process for intensifying. To give the wished-for intensity to a proof developed by means of iron, it is merely needful to blow upon the plate submitted to the developing-bath by means of a glass tube half a centimetre in diameter; a small piece of sponge is fixed at the end of the tube to prevent the projection of saliva. A little skill is needed to give the proof uniform intensity.

Mitchell's formula for gun-cotton, said to be at once the most explosable and the most soluble in alcoholic ether, was quoted.

A discussion took place on an article by Mr. Wharton Simpson in the *Photographic News*.

M. Derogy presented a new enlarging mirror, moved by clockwork, and playing the part of a heliostat.

M. Davanne presented to the Society a travelling camera invented by M. Durand, an amateur. This apparatus is described at length, but its construction can scarcely be understood without the aid of an illustration.

M. Puttemans presented to the Society various specimens illustrating his process for transforming photographs into oil paintings, and gave an experimental illustration of the method.

M. Franck de Villecholle called attention to the yellow spots which appear on photographs, very common in some ateliers. He considers it due to a decomposition of the glue. He recommends the addition of a trace of alum.

Influence of Colour upon the Reducing Action of Light.—Carey Lea.—The author gives an account of the experiments he has carried out with per-salts of iron, bichromate of potash, ferridcyanide of potassium, and nitrate of uranium. He finds that corallin increases the sensibility of chloride of silver for all the rays, especially the blue and the violet. Rosanilin increases the sensibility for the same two rays, but lessens it for all others. Aniline blue lessens the sensibility for the green, augments it for the yellow, and is without action for the rest. Aurin produces a general decrease of sensibility. Mauvein and aniline green have no action. Litmus reddened by acetic acid greatly augments the action of the blue and the violet.

Heliochromy.—Ducos du Hauron.—A paper on the production of photographs in their natural colours. The author's views coincide with those of M. C. Gros.

Annalen der Physik und Chemie, von Dr. J. C. Poggendorff, No. 6, 1874.

Reflection of Light from the Surface of Isotropic Bodies.—G. Lundquist.—The first portion of a long and important memoir, consisting to a great extent of mathematical formulæ, and incapable of useful abstraction.

Medium in Electric Induction.—Dr. H. Brongersma.—The object of this paper is to justify Faraday's theory of electric action without contact (Faraday's "Experimental Researches," 1669 and 1670), against the objections raised by Riess and others.

Communications from the Mineralogical Institute of the University of Strasburg.—These communica-

tions include a notice—(1) *Crystalline Form and Thermo-Electric Properties of Speis-cobalt*, by Paul Greth. The results arrived at are that speis-cobalt shows in general merely the crystalline forms of the regular system, common to its holohedric and hemihedric section with parallel surfaces, namely, $\infty O\infty$, O, ∞O, $2O2$, whence it has been hitherto considered as holohedric. Other surfaces are rarely found such as $\infty O3$, $\infty O5$, $\infty O10$, and hexakis-octahedra, but these appear always hemihedrically as pentagon dodecahedra and diakis-dodecahedra. Hence speis-cobalt forms pentagonal-hemihedral crystals. This mineral has the physical peculiarity that the majority of its crystals are thermo-electrically negative to copper, whilst a portion are positive. This peculiarity has been detected in no other body except iron-pyrites and glance-cobalt, two minerals whose chemical constitution is analogous to that which may be deduced from the analyses of speis. The hemihedrism and the thermo-electric properties of speis-cobalt prove that it is perfectly isomorphous with iron-pyrites and glance-cobalt, and that its chemical composition is, therefore, $(Co,Ni,Fe)AS_2$.

(2) *Chemical Composition of Leadhillite.*—Dr. C. Hintze.—The author proves that leadhillite is not $PbSO_4 + 3PbCO_3$ as formerly assumed, but $2PbSO_4 + 4PbCO_3 + PbO + 2H_2O$. The supposed new mineral, maxite, discovered by Prof. Laspeyres in the lead mine Mala-Calzetto, near Iglesias, in the island of Sardinia, is identical with leadhillite.

(3) *Crystallographic Examination of Compounds of Aldehyds with Hydrocarbons of the Aromatic System.*—Dr. C. Hintze.—This paper does not admit of useful abstraction.

(4) *Twin-Growth of Willemite.*—Dr. A. Arzruni.—The forms found in certain crystals are ∞R and $\frac{3}{4}R$, as may be proved by measurement. The twin surface is a plane of the pyramid of the second order, $\frac{3}{2}PQ$.

(5) *Optical Examination of Hydrated Oil of Turpentine.*—Dr. A. Arzruni.

(6) *Optical and Crystallographic Investigation of certain Bodies like Urea.*—Dr. A. Arzruni.

(7) *Two Isomorphous Derivatives of Benzol.*—Dr. A. Arzruni.—These three papers are not adapted for abstraction.

State of Aggregation of the Solar Spots.—F. Zöllner.—The author maintains that the spots are solid slag-like masses floating on the liquid surface of the sun.

On Ozone.—T. Andrews.—A paper read before the Royal Society of Edinburgh.

Measurement of Terrestrial Magnetism.—Dr. K. Braun.—The first portion of a memoir on the precautions needful to ensure accuracy in the determination of the three magnetic elements.

Polarisation of Zodiacal Light.—Prof. A. W. Wright.—From the *American Journal of Science*, vol. vii.

Diffusion Between Dry and Moist Air.—E. Reusch.—A description of a diffusion-tube with a plate of hydrophane.

A Diffraction Grating for Spectroscopes.—From the *American Journal of Science*, vol. v., p. 472.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, No. 8, 1874.

M. Moigno, speaking of Prof. du Bois-Reymond, calls him "le plus Prussien des savants Prussien."

Observations on the Construction and Maintenance of Lightning Conductors.—A notice of a work by R. Francisque-Michel. The editor describes the conductors of Paris generally as being in a deplorable condition, calculated to endanger rather than protect the buildings to which they are attached. Several improvements are recommended, which are shown in the accompanying illustrations.

Nos. 9 and 10, 1874.

This double number is chiefly taken up with a report of Dr. Tyndall's Belfast speech.

Maps with Soluble Ferro-Prussiate.—Paper prepared with cyanate of iron is recommended for reproducing plans, maps, &c. After exposure it is washed with water, which fixes the design.

No. 11, 1874.

This number opens with a letter from the editor to Dr. Tyndall, of a character utterly unfit for our columns.

The yield of the gold mines of French Guayana for the year 1873 is officially stated at 832·344 kilos.

Reimann's Farber Zeitung, No. 39, 1874.

This number contains a notice of M. Schlumberger's aniline black; receipts for dyeing a fast grey, a sea-green, and a fast green on woollen yarn; a straw-colour on cotton piece goods; a brown, a violet-blue, a blue, and a red on horse-hair; a blue, a royal blue (which, however, contains no prussiate), and an aniline blue on felt hats; instructions for ungumming silk, which is directed to be worked in two soap-baths, the first containing 4 ozs. and the second 3 ozs. per pound of silk. There are further receipts for an orange resist for vat-blues, and for a red, white, and black on calico and muslins.

Removal of Nitric Acid Stains.——These well-known yellow stains can be removed either from the skin or from brown or black woollen garments, by moistening the spots for a while with permanganate of potash, and rinsing with water. A brownish stain of manganese remains, which may be removed from the skin by washing with aqueous solution of sulphurous acid. If the spots are old they cannot be entirely removed.

Oxide of Chrome as a Mordant.—In the *Journ. de la Soc. Indus. de Rouen* M. Gros-Renaud describes the action of chromic oxide as a mordant. It gives with madder a reddish colour; with logwood, black or grey; with the red woods, brown and lavender; with cochineal a crimson; and with yellow dyes a yellow. With catechu brown two yellow tones are produced. If chromic oxide is steamed it does not lose the property of taking up colour from dye solutions. Acetate of chrome is therefore successfully used as a mordant for steam colours. Chrome-alum has been found inapplicable for this purpose. Nitrate of chrome gives very dark shades, it does not weaken the fibre, and is not deliquescent. The solution of the acetate of chrome, obtained by double decomposition of sulphate of chrome and sugar of lead, is more stable than acetate of alumina. Its solutions are not decomposed by boiling, but if steamed it gives up its base to the fibre. It does not coagulate thickeners at common temperatures. To fix the hydrated sesquioxide of chrome upon tissues, they are dyed or printed with the solution, and then winced through a weak soda-bath (3° B.) at 48° C.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of the salts, carbonates, and hydrates of baryta and strontia, and also for improved modes of making baryta and strontia caustic. Edward Thomas Hughes, of the firm of Hughes and Son, patent agents, Chancery Lane, London. (A communication from Louis Gustave Ghilain Daudenart and Edmond Verbert, Rue du Progrès Schaerbeek, Brussels.) March 13, 1874.—No. 911. To procure the carbonates of baryta and strontia, alkaline earthy chlorides are dissolved in water to 12° or 15° B., and the solution, whether of the chloride of barium or the chloride of strontium, is mixed with hydrate of magnesia in a vessel, which is afterwards closed. The mixture is kept in continual agitation, and subjected to the action of a current of carbonic acid, which being absorbed by the magnesia forms a carbonate of this base, and by the employment of an excess of carbonic acid the decomposition is rapidly effected, and the alkaline earths produced free from carbonate of magnesia. In practice, the treatment of the alkaline earthy chlorides by magnesia and carbonic acid is effected in two operations. In the first, the magnesia is in excess, which gives when the reaction is terminated a liqdor containing xclusively chloride of magnesium, which is decanted, and a precipitate obtained consisting of a carbonate of the alkaline earth, and the magnesia employed in excess in a carbonated state, which excess is neutralised in the second operation by an additional quantity of the alkaline earthy chloride. The liquor containing the chloride of magnesium is concentrated by evaporation, and the hydrated chloride of magnesium submitted to the action of steam superheated to about 300° C. without pressure, so that it becomes completely decomposed, and is in the condition to be rapidly hydrated and carbonated. To manufacture caustic baryta and strontia from their carbonates, the carbonate is mixed with carbon or chalk, and the mixture, whether subjected or not to the action of superheated steam, is heated in a regenerating or reverberatory furnace.

Improved means of and compositions for preserving wood and other materials and structures, and for rendering them fireproof. Cristoforo Muratori, Burton Crescent, Middlesex. March 14, 1874.—No. 931. This relates to compositions in which waste skin cuttings, alum, gum, and water form a body to be mixed with wood, stone, metal, or other body in a state of powder for covering corresponding bodies or others and coating them to resist the action of fire.

Improvements in the purification of gas and gas-liquor. F. C. Hills, manufacturing chemist, Chemical Works, Deptford, Kent. March 14, 1874.—No. 934. This invention relates to a process described in the Specification of Letters Patent, No. 1369, 1868, and consists of certain improvements in purifying gas-liquor and in using gas-liquor for the purification of gas. The crude gas-liquor is run either direct or through a scrubber to a still in which the said liquor is kept at a temperature of about 180°, whereby carbonic acid, sulphuretted hydrogen, and ammonia are driven off. These products pass from the still up through the said scrubber, the greater part of the ammonia being condensed and carried back to the still by the descending gas-liquor when the said liquor is passed through the scrubber, while the sulphuretted hydrogen and carbonic acid gases escape at the upper part of the scrubber with a little ammonia, which latter may be taken up by water, acid, or other suitable agent. The carbonic acid and sulphuretted hydrogen may be passed through oxide of iron to collect the sulphur. The crude gas-liquor before being run into the still may be kept for some time at a temperature of about from 160° to 170°, and the sulphuretted hydrogen then given off may be used for making sulphide of lime or sulphide of ammonia. The gas-liquor, treated as described, may be used for purifying gas. Crude gas-liquor is made to combine with more of the carbonic acid combined with gas, and thus to free the said gas from such acid by passing such gas direct from the hydraulic main at a temperature of 160° into a scrubber.

Improvements in the production of tannin. Paul Phillippe Francois Michea, Leadenhall Street, London. March 18, 1874.—No. 957. This invention relates to a process for the production of tannin from tannin-bearing plants, trees, fruits, leaves, barks, or extracts thereof. The tannin is first extracted from the said plants, trees, or other substances by maceration or decoction in water, to which is added soluble salts of magnesia or lime, or sea-water may be used, or a solution of common salt, or of sulphate of soda. The extract obtained is treated with alkali or with alkaline earths, or their soluble carbonates or hydrates, for the precipitation of the tannin, the precipitate is collected and washed, and is then ready for use in a moist or dried state. When used for dyeing it is suspended in water with the addition of a small quantity of acid, whereby the precipitate is dissolved, and a solution of tannin is obtained in a more or less concentrated state.

Improvements in the manufacture of artificial butter. Alexander Melville Clark, patent agent, Chancery Lane, Middlesex. (A communication from Louis Dordron, Alexandre Villeron, and Jacques Auguste Bezinge, all of Paris.) March 25, 1874.—No. 1049. This artificial butter is composed of fresh beef and veal suets, milk, and oil in suitable proportions, and prepared by working up in a mixer.

Improvements in the manufacture of waterproof plates or panels applicable for sheathing and roofing, and in the manufacture of packing and other cases, tanks, hollow spheres, cylinders, and such like, from paper or other ligneous tissues prepared with cupro-ammonium. Yorick Jones Murrow, Tavistock Square, Middlesex. March 26, 1874.—No. 1063. The claims to this Complete Specification are— (1) The mode herein described of manufacturing waterproof thick tissues from cupro-ammonialised paper or other ligneous material by the alternation of wet and dry sheets: also the application of such waterproof tissues to the various purposes herein specified. (2) The mode herein described of preparing millboard and such like thick paper tissues prior to forming slabs or plates from them. (3) The manufacture of packing-cases, tanks, hollow spheres, cylinders, tubes, boxes, and such like from the waterproof tissues substantially as herein described. (4) The moulding of cupro-ammonium-prepared tissues into various hollow forms by subjecting such tissues to internal fluid pressure whilst they are held within an external mould of the desired form.

MEETINGS FOR THE WEEK.

MONDAY, 21st.—Medical, 8.
——— London Institution, 5.
TUESDAY, 22nd.—Civil Engineers, 8. (Anniversary.)
——— Anthropological, 8.

TO CORRESPONDENTS.

Equivalent.—Before inserting your letter we must receive your name and address; not, however, for publication.
J. W.—Send the particulars for our perusal.
G. P.—Please explain more clearly your requirements.

THE CHEMICAL NEWS.

VOL. XXX. No. 787.

EXPERIMENTAL RESEARCHES ON VEGETATION.

THE EMPLOYMENT OF VEGETATION TO ASCERTAIN AND
DEFINE THE MOLECULAR STATE OF BODIES;

THE ANALYSIS OF VEGETABLE EARTH BY RATIONAL
METHODS OF CULTURE.

By M. GEORGES VILLE.
[(Concluded from page 280).

II.—For a long time, chemists have ignored, or misunderstood, the true nature of urea. The multiple, and sometimes contradictory, reactions that this body presents have led to much divergence of opinion and to different interpretations. Urea changes with wonderful facility into carbonate of ammonia. The simple contact of a nitrogenous matter in the act of decomposition is sufficient for that. If we add that urea possesses the composition of carbonate of ammonia, less four equivalents of water, it is not surprising that certain chemists have thought of deriving one from the other. However plausible it seems, this conjecture is still open to criticism. When a solution of cyanate of ammonia is evaporated, the liquid deposits crystals of urea. If a mixed solution of urea and nitrate of silver is concentrated, a mixture of nitrate of ammonia and cyanate of silver is pruduced. The reactions are of a nature to justify the opinion of those who admit the existence of cyanic acid in urea. But, contrary to the properties of ordinary salts, urea possesses the power of combining with acids, and forming with them true salts, or at all events compositions which greatly resemble them. Thus, certain chemists have considered urea as the oxide of a radical compound, participating at the same time in the properties of ammonia and cyanogen. In this supposition, urea becomes a double oxide of cyan-ammonium and hydrogen—

$$\left.\begin{array}{l} NH_3CyO \\ HO \end{array}\right\}$$
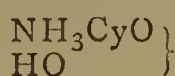
It is true that the uncertainty there has for some time been felt on the true nature of urea is now likely to cease. Its production by means of chloro-carbonic acid, explained by the new theories on the amides introduced into science by M. Dumas, more recently by the remarkable works of M. Wurtz on the production of compound ureas, is favourable to the idea that urea is really di-ammonia, in which the radical carbonile replaces a double equivalent of hydrogen, H_2. But, with all deference to the opinion which ought definitely to prevail among chemists, let us fix, by their symbols, the three formulæ which we have just referred to, and, without any pre-conceived ideas, let us ask vegetation to decide.

Urea.

Liebig.	Gerhardt.	Wurtz.
Abnormal Cyanate of Ammonia.	Oxide of Cyan-Ammonium.	Di-Ammoniac Carbonile.
$C_2O_2N_2H_4$	$\left.\begin{array}{l} NH_3CyO \\ HO \end{array}\right\}$	$N_2\left\{\begin{array}{l} H_2 \\ H_2 \\ C_2O_2 \end{array}\right.$

Urea produces on vegetation a most favourable and active influence. Its effects equal those of ammoniacal salts. If cyanic acid enters into its composition, this product itself ought to be as active as ammoniacal salts. But see how different are the results. The cyanates do not exercise an appreciable influence on vegetation. Under this form, nitrogen is not assimilated; its passivity

is absolute, as may be easily seen by the following results:—

1862.—*Cultivation of Buckwheat.*

Dry Product.	0·110 of Nitrogen in the state o	
	Urea.	Cyanate of Potash
	Grms.	Grms.
Roots and straw ..	7·93	1·43
Seeds	2·44	0·00
	10·37	1·43

After this proof of the neutrality of cyanates, is it right to consider cyanic acid amongst the constituents of urea? The idea of representing urea as oxide of cyan-ammonium and hydrogen, adopted by Gerhardt in his great "Treatise on Organic Chemistry," does not accord better with the testimony of vegetation. Numerous experiments have shown me that, in an artificial soil of calcined sand, the cyanides and ferrocyanides were neutral, or decidedly noxious, whilst the neutrality of cyanates was already known to me.*

We must rest, then, in the supposition that urea belongs to an ammoniacal type, from which, however, it differs by its double atomicity and by the substitution of the radical C_2O_2 for H_2.

If such is really the true nature of urea, its action on vegetation explains itself, and I add that chlorhydrate of ethylamine having produced as much effect as sal-ammoniac, this similarity of action ought to extend to urea itself; and experience confirms this supposition in the most satisfactory manner.

1862.—*Cultivation of Wheat.*

Dry Product.	0·110 of Nitrogen in the state of	
	Urea.	Sal-Ammoniac.
	Grms.	Grms.
Roots and straw ..	15·07	14·66
Grains	2·43	2·71
	17·50	17·37

1861.—*Cultivation of Wheat.*

	Urea.	Sal-Ammoniac.
Roots and straw ..	15·49	14·97
Grains	2·19	2·45
	17·68	17·42

Consequently the formula—

$$N_2\left\{\begin{array}{l} H_2 \\ H_2 \\ CO_2 \end{array}\right.$$
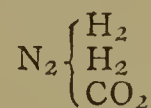
is exactly that which best explains urea.

If this deduction be thought premature, and the test on which it is founded incomplete and insufficient, we have the means of controlling and re-affirming it.

Oxamide is derived from oxalate of ammonia exactly as urea from carbonate. Oxamide and urea are formed in the same manner, by the condensation of two equivalents of neutral salt, followed by the elimination of four equivalents of water.

Carbonate of Ammonia.   Urea.

$$2NH_4O,CO_2 - 4HO = N_2\left\{\begin{array}{l} H_2 \\ H_2 \\ C_2O_2 \end{array}\right.$$

Oxalate of Ammonia.   Oxamide.

$$2NH_4O,C_2O_3 - 4HO = N_2\left\{\begin{array}{l} H_2 \\ H_2 \\ C_4O_4 \end{array}\right.$$
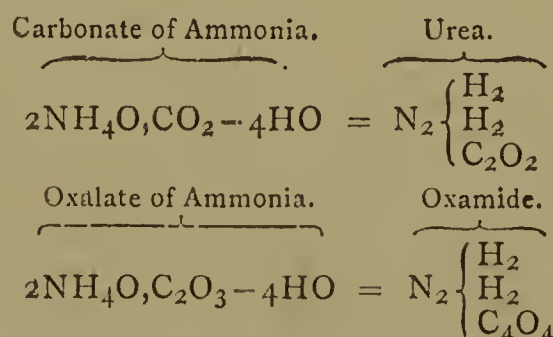
Urea and oxamide result from a similar method of generation; their constitution corresponds on all points.

* This proof could only be defined after having experimented on cyanogen compounds, such as cyanamide; thus it is a point still in reserve.

Ought not oxamide, therefore, to exercise a favourable influence on vegetation, and its effects be equal to those of oxalate of ammonia ?* But on this question experiment has answered as follows :—

1861.—*Cultivation of Buckwheat.*

o·110 grm. of Nitrogen in the state of

Dry Product.	Oxalate of Ammonia.	Oxamide.
	Grms.	Grms.
Roots and straw ..	5·67	5·00
Seeds	1·17	1·05
	6·84	6·05

1861.—*Cultivation of Wheat under the same conditions.*

Roots and straw ..	8·30	8·35
Seeds	2·08	1·84
	10·38	10·19

Thus is justification found for what I have said at the commencement, that vegetation offers us unhoped-for resources in penetrating the molecular state of bodies, even to giving to their formulæ one more degree of accuracy. Thus, the first part of the programme which I have placed before you is found complete.

In a second article, I shall show how it is possible, by an extension of the same methods of experimentalism, to discover in the soil the presence of phosphate of lime, potash, lime, humus, and active nitrogenous compounds—in a word, all the regular agents of vegetable production—and how we are authorised to found, on the knowledge of these results, a practical method of analysis for the use of agriculturists.

ON THE EFFECT OF HEAT ON IODIDE OF SILVER.†

By G. F. RODWELL, F.R.A.S., F.C.S.

PROFESSOR CLERK MAXWELL, when discussing the expansion of matter by heat ("Theory of Heat," p. 8) says, "The body generally expands (the only exception among solid bodies, as far as I am aware, is the iodide of silver, which has been found to contract as the temperature rises.)" M. H. Fizeau, speaking of the same substance ("Nouvelles Observations relatives à l'iodure d'argent") writes as follows:—"Ce corps, en effet, paraît offrir l'exemple d'une inversion complète des phénomènes ordinaires de la dilatation par la chaleur, car son volume diminue très-certainement pendant l'échauffement et augmente pendant le refroidissement."

It was thought that a substance possessing so marked a property would probably exhibit peculiarities of molecular structure, and the following experiments were made in order to determine whether such peculiarities exist, to note the effects of higher temperatures upon the iodide than those employed by Fizeau (which in no instance exceeded 100° C.), and to determine the point of maximum density of the iodide. The phenomena which most closely approximate to those assigned to the iodide of silver when heated, are to be found in the case of the anomalous expansion of ice and bismuth, and a few other substances which at the moment of fusion, and for a few degrees above their point of solidification, exhibit contraction on being heated ; but in these instances we have to bear in mind that a change of state is simultaneously effected, or about to be effected in the substance. Again,

certain crystals contract in the direction of one of their axes on the application of heat, but they expand in the direction of another axis, and the total expansion is greater than the contraction, so that they possess a positive coefficient of expansion. Garnets and a few other crystals undergo an increase of sp. gr. on being strongly heated, and slowly recover their original density.

The iodide of silver, on the other hand, when far removed from the point at which it undergoes any change of state, appears to exhibit contraction, to possess what M. Fizeau calls a "negative coefficient of expansion;" and this is the more remarkable when we remember that the chlorides, bromides, and iodides, of potassium, sodium, and ammonium, and the chloride and bromide of silver expand considerably when heated, more so indeed than the most expansible metals, such as lead, tin, and zinc. The contraction of the iodide of silver is, according to Fizeau, quite regular between − 10° C. (14° F.) and +70° C. (158° F.) ; and he calculates that the contraction is equal to about $\frac{1}{2000}$ of its volume at 0° C. for 100° C. ; or, again, equal to $\frac{1}{6}$th the expansion of platinum for 100° C. He also found that a large hexagonal crystal exhibited a very considerable contraction in the direction of the axis of symmetry, while a slight expansion was produced in a direction normal to the axis of the crystal.* The contraction was observed in the case both of the crystal, a confused crystalline mass, and an amorphous mass produced by strongly compressing the precipitated iodide until it became a hard mass capable of receiving a fine polish, and possessing a sp. gr. of 5·569. Fizeau considers that that the iodide possesses its maximum of volume or minimum of density at a temperature, of − 60° C. (− 76° F.).

The iodide of silver employed in the following experiments was prepared :—(1) By precipitation. Pure iodide of potassium was added to nitrate of silver, both in dilute solution. The precipitated iodide was thoroughly washed in the dark, slowly dried, fused in a porcelain crucible, and cast into cylindrical masses, either in a warm porcelain or brass mould.† (2) By dissolving pure silver in strong hydriodic acid, evaporating to dryness, fusing. (3) By exposing pure silver leaf for several hours to the vapour of iodine produced by spontaneous evaporation.

Before we examine the effects of heat upon the iodide, it may be well to say a word or two concerning the action of light upon it. A considerable amount of misconception appears to exist in regard to this. Gmelin says "it turns brown on exposure to light, but less quickly than the chloride ;" Miller says "it is but slowly acted upon by light ;" Fizeau describes it as, "noircissant lentement à la lumière ;" while Vogel ("Jahresbericht," 1863) affirms that if it be precipitated with excess of iodide of potassium it is scarcely affected by light, whereas if precipitated with excess of nitrate of silver it changes colour, but undergoes no chemical change. The general idea that it is nearly as sensitive to light as the chloride, has no doubt arisen from the fact that iodides and chlorides are known to have many points of resemblance, and that the iodide is largely used in photography ; moreover we remember that a thin film of iodide of silver was the sensitive medium in the original daguerreotype. But we must bear in mind that the change produced by light is not apparent until the so-called "developing solution," which contains reducing agents, has been employed. The change is indeed most obscure ; the author of the article on Photography in Watts's "Dictionary of Chemistry" says of it, "The atoms have apparently acquired a certain degree of mobility, in consequence of which, when submitted to the action of reducing agents, such as ferrous sulphate or pyrogallic acid, they suffer decomposition, the silver being reduced to the metallic state, and forming an opaque metallic film on the parts of the surface which have been exposed to light."

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* For equal proportions of nitrogen, oxamide produces half as much effect as urea, and oxalate of ammonia half that of sal-ammoniac. When I treat of the actions of salts and derivatives of aniline, I will give the cause of this difference.

† A paper read before the Royal Society.

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* "Sur la propriété que possède l'iodure d'argent de se contracter par la chaleur et de se dilater par le froid," Comptes Rendus, 1867.

† I must express my indebtedness to Mr. Valentin for allowing me to have a quantity of iodide prepared at South Kensington.

The following experiments were made to determine the degree of sensitiveness of the iodide to light :—

a. By means of a large lens the rays of the electric lamp were brought to a focus within a glass cell containing a solution of iodide of potassium ; a solution of nitrate of silver was then introduced by a pipette at the apex of the cone of rays. The precipitated iodide possessed its usual pale yellow colour.

β. Freshly precipitated iodide in suspension, with a slight excess of iodide of potassium, remained in the full glare of a July sun without undergoing any perceptible change ; neither did it subsequently darken.

γ. Freshly precipitated iodide in suspension, with a slight excess of nitrate of silver, underwent no immediate change on exposure to a July sun. At the end of an hour it had become slightly grey, and subsequently darkened.

δ. Organic matter in the shape of starch-paste did not induce any change when mixed with freshly precipitated iodide in suspension with a slight excess of iodide of potassium. Albumenised paper with iodide precipitated upon it did not undergo any immediate change.

ε. Some dried and powdered iodide was found to have acquired a slight greyish metallic tinge after an hour's exposure to the sun. A freshly broken surface of fused iodide became very slightly darker after exposure to the sun. A very pale microscopical crystal of iodide, removed from the interior of a crystalline mass, became slightly brown after several hours' exposure to diffused light.

ζ. Crystals of iodide of silver produced by direct solution of silver in hydriodic acid were not affected by light ; neither were crystals of hydro-argentic iodide (Ag IHI), nor crystals of argento-potassic iodide (Ag IKI).

θ. A sheet of silver leaf was exposed to the vapour of iodine (produced by spontaneous evaporation) for five minutes ; it possessed a faintly yellow tinge, which on exposure to the sun instantly became pale green, but on further exposure returned to its original pale yellow. A second sheet was exposed for ten minutes to the vapour of iodine ; it acquired a golden-yellow surface, which on exposure to diffused light acquired a purplish-red colour, and on exposure to the sun became greenish purple. On continued exposure this colour disappeared, and the plate returned to almost the original yellow colour.

ι. A sheet of silver leaf was exposed to the vapour of iodine for half an hour, at the end of which it possessed a decided golden-yellow colour ; on exposure to the sun it instantly acquired a dark purple colour, edged with green at those parts least exposed to the direct vapour of the iodine. On continued exposure the purple became paler, but the sheet did not return to its original yellow colour.

κ. A developing solution composed of ferrous sulphate, alcohol, acetic acid, and water, when applied to the exposed sheets of θ and ι, which had been purple, but on continued exposure nearly regained their original colours, produced a reddish-brown colour.

λ. A sheet of silver leaf was exposed to the vapour of iodine for many hours ; it was found to be converted into a slightly coherent film of lemon-yellow iodide. Light had no effect upon it, even after long exposure to a July sun ; neither was any colour produced on the addition of a developing solution.

The pure iodide of silver would thus appear to be scarcely affected by light, except when silver is present, either in the form of nitrate, or as in the case of the silver films, as metallic silver.

If the precipitated iodide of silver be fused it is found to cool to a greenish-grey mass, which in thin layers is translucent. The surface has sometimes a dark steel-grey, semi-metallic appearance, but this does not affect the composition. Sometimes, without any apparent cause, the ordinary greenish surface and the dark steel-grey may exist side by side in the same fused mass. A second fusion may produce a uniformly greenish surface, or a uniformly steel-grey surface. But whatever the appearance of the fused mass, it always furnishes when pulverised a lemon-yellow powder, which, when heated, remains unaltered in colour up to about 105° C. (221° F.). At that temperature it begins to darken, and between 105° C. and 180° C. (356° F.) it assumes darker and darker shades of yellow, passing into orange and orange-red ; above 180° C. it becomes decidedly red, and darkens through temperatures which may be roughly indicated by the fusing-points of tin, lead, and zinc, until at the latter temperature (412° C., 773° F.) it possesses a very dark brick-red colour. At this temperature the powder becomes coherent, but does not commence to fuse. At a somewhat higher temperature, probably about 450° C. (842° F.), the iodide fuses to a dark-red liquid, the colour of bromine, or of melted sulphur shortly before its boiling-point. At a red heat the iodide begins to volatilise and to decompose, and at a bright red heat this takes place readily. If the iodide be fused and poured into cold water, it becomes a lemon-yellow, amorphous, very brittle mass.

If the fused mass of iodide is allowed to cool, it solidifies to a dark-red transparent body, which is somewhat plastic. On further cooling it becomes much paler in colour, still remaining transparent ; and if cooled as a thin film in contact with a hot surface, it passes to a pale yellow transparent variety. The transparent varieties, at a temperature which varies with the mass of the substance, and which in the case of a thin film may be as low as 105° C., become crystalline, opaque, and of a pale greenish-grey colour, somewhat brittle, and of a granular fracture. At the moment of the change from the amorphous, transparent, plastic variety to the opaque, brittle, crystalline variety, considerable expansion takes place, often accompanied by a loud cracking, and large fissures appear in the mass.

Many attempts were made to determine the precise temperature at which the change from the amorphous to the crystalline condition takes place ; but the results were somewhat discordant, depending apparently on the mass of the iodide, and perhaps on the number of times it had been previous fused. The iodide was fused in a glass tube or porcelain crucible, and when fusion was quite complete was placed in an air-bath at 150° C. (302° F.), and allowed to cool. The exact temperature at which the tube was broken by the expanding mass was noticed. About 15 grammes of iodide, which had been often fused, changed suddenly from the amorphous to the crystalline condition at 120° C. (248° F.). Another specimen cracked the tube at 116° C. (240·8° F.). A porcelain crucible containing 10 grammes of the fused iodide commenced to change at 118° C. (244·4° F.) ; the crucible was violently riven open at 105° C. Two small test-tubes, about 6 millimetres diameter and containing 2 grammes of iodide apiece, were placed in the hot-air bath ; the two masses of iodide simultaneously changed to the crystalline condition at 109° C. (228·2° F.). On one occasion a small mass weighing 3 grammes, prepared by dissolving silver in hydriodic acid, was fused in a tube and slowly cooled. It cooled down to the ordinary temperature of the air without breaking the tube ; on moving the tube, however, the mass suddenly underwent molecular change, and the tube was broken. The same iodide fused with some which had been similarly prepared suddenly changed to the crystalline variety at 121° C. (249·8° F.). From the above results we cannot be far wrong in stating that the change from the amorphous to the crystalline variety of the iodide takes place at a temperature of about 116° C. (240·8° F.).

Presumably heat is evolved when the amorphous modification of the iodide passes into the crystalline. Several attempts were made to ascertain this by plunging a mass of hot amorphous iodide into hot mercury, inserting a thermometer, and allowing the whole to cool, but no rise of temperature was observed at any given point of the cooling.

If the fused iodide be cast into a tube of porcelain or brass the following effects may be observed :—(*a*) The mass contracts considerably at the moment of solidification, the level liquid surface sinking into a deep conical depression when it becomes solid. (β) For many seconds

after the solidification the solid cylinder of iodide will freely slip out of the tube, and is then seen to be red and transparent, in fact in the amorphous condition; but (γ) if the mass cools until it assumes the crystalline condition it can no longer be got out of the tube; and if the latter be of glass or porcelain, it is infallibly broken by the expansion.

Hence if a mass of iodide be allowed to cool in the tube which it cannot break when it expands, it may be made to contract and slip easily out of the tube by heating it. Hence, also, as the change from the amorphous to the crystalline condition takes place at 116° C., it would appear that between the point of fusion, 450° C. and the temperature at which the amorphous iodide becomes crystalline, it follows the ordinary law and contracts as it cools, while below that temperature (and as will be shown as low as −18° C. (−0·4° F.) it expands on getting cooler, and possesses a negative coefficient. It thus appears that when the iodide is in the amorphous condition at 116° C., immediately before the change to the crystalline condition, it is at its point of maximum density.

Several unsuccessful attempts were made to burst metal bottles, after the manner of the familiar ice-experiment by the expansion of the iodide at the moment when it passes from the amorphous to the crystalline condition. On one occasion, when a somewhat large cylindrical mass had been cast into a tube of thin brass, the latter was burst by the expanding iodide, but thick metal bottles, furnished with a screw, which was forced down into the molten mass, were not broken. Thick porcelain and glass tubes were invariably broken by the expansion, and a good lecture experiment to illustrate the anomalous expansion is furnished by the following means. Let 20 or 30 grammes of fused iodide be cast into a thick cylindrical tube of porcelain a centimetre diameter; in the course of a minute or two the mass has cooled down to the temperature at which it changes from the amorphous to the crystalline condition; it then expands, cracks the tube with a loud noise, and sometimes jerks portions of the tube to a distance of several feet.

A curious effect was noticed in the case of bars of the iodide during cooling. If a bar be cast in a tube and pushed out before it begins to expand, it is seen to curve considerably during cooling. In the case of a bar 15 centimetres long by 6 millimetres diameter, the curvature was such as would be produced with a radius of 48 centimetres, and was always the same with bars of the same length and diameter. A very slight pressure resisted the tendency of the bar to curve. The effect was not due to conduction of heat from one part of the bar, while the rest remained perfectly hot; for the effect was the same whether the bar was allowed to cool on a flat copper plate, in an air-bath, or even if it were suspended by a thread of non-conducting matter. It takes place when the iodide passes from the amorphous to the crystalline condition, and is no doubt due to the inequality of strain produced between the outside portions which first become crystalline and expand, and the internal portions which assimilate the change less rapidly, for the iodide is a very bad conductor of heat.

(To be continued).

ON THE

EVOLUTION OF HEAT DURING THE HYDRATION OF CLAY-SLATE, CLAY, AND COAL.

By WILLIAM SKEY.

HAVING announced, in November, 1871,[*] that clay-slate hydrates when in contact with water, as shown by the coagulation test I devised, I have been desirous to obtain

* "Proceedings of New Zealand Institute," vol. iv., p. 381.

corroborative evidence in support of this statement, and so prosecuted the matter further; and being under the impression that the hydration of this substance would evolve heat, I ground some clay-slate to a very fine powder and put it to a small quantity of distilled water, when an elevation of temperature occurred in the mixture equal to about 2° F. above the temperature of the materials used.

To make sure that none of this rise was due to heat generated during the act of crushing and retained in such a manner, that the exact temperature of the powdered substance could not be ascertained, I repeated the experiment, but with this variation—the crushed slate was bottled off and not used till 24 hours afterwards. The thermometric results were the same.

The water after the mixing was slightly alkaline, owing no doubt to the presence of a minute quantity of alkalies derived from the slate, to the hydration of which or their compounds a part of the elevation of temperature noticed might have been due. To obtain, therefore, some indication of the quantity of this, I crushed some glass to quite as fine a powder as I had the slate instanced, allowed it 24 hours to cool (as I may state here I have for all succeeding experiments upon substances dried by heat), and then mixed it with water in same proportions as observed for the slate, when an elevation of temperature barely equal to 1° F. occurred. The water was of course strongly alkaline directly after the mixing was performed; clearly, therefore, the alkalies of the slate had no important share in producing the elevation of temperature observed.

At this stage I struck aside a little to experiment upon coal, clay, and other substances, in the hopes of obtaining facts extending over a wider field, and so capable of being handled more correctly and with greater ease, and I found carbonate of lime, as also quartz and brown coal or clay, did not give any indication of an evolution of heat when mixed with water; steatite, however, and anhydrous coal, also hydrous coal, clay, and lignen, when dried gently or wholly, did so.

Steatite had as much heating power as slate, while all the remaining substances cited were superior to it in this respect.

In the case of naturally anhydrous coal, or hydrous coal and clay dried at from 90° to 212°, or over desiccating substances (at common temperatures), I frequently obtained a rise of temperature from 3° to 6° F.

These results tend to show that, as a general rule, any so-termed hygroscopic substances, when deprived of even the smallest portion of their water, and then allowed to regain this by giving them contact with water, generate heat.

It will at once appear that, if in place of submitting water to these dried substances we submit aqueous vapour, the evolution of heat would be much greater, or would last longer, and in fact I find that these substances desiccated and exposed to common air rise in temperature very notably.

It only remains now to consider how much of this elevation of temperature is due to mechanical, and how much to chemical agency.

It is obvious a portion of this is due to friction, occasioned by the rapid inrush of water to the pores of these substances.

I believe the calorific effect of such inrushes has not yet been measured, if indeed noticed before, and in all likelihood they will be deemed so small as to be barely perceptible, or at most not at all necessary to take into account in determining the origin of the increase of temperature instanced, but as I felt anxious to get the approximate calorific result due to chemical agency, I have made an attempt to get at this by comparative tests.

In this attempt I substituted other liquids for water liquids which, experimentally, I found had no action upon the solids used, or only to a very minute extent.

My results were as follows :—

I. Clay-slate mixed with water raised a thermometer placed in the mixture 2° F. above the temperature of these substances, just before mixing them. A po: tion of the same sample of clay-slate, and in qu ntity as before, mixed with pine kerosene in san e volume as that of the water used, only raised the thermometer 1¼° F.

II. Dried brown coal, similarly treated, gave an elevation of temperature equal to 4° F. with water, and only 2° F. with oil. The same conditions were observed as to quantities and volumes as in the first expriment.

As the kerosene used would have a less specific heat than water, the amount of heat due to friction in the first experiment would not be *so much as* 1¼°, and in the second experiment not *so much as* 2°, leaving a balance of heat equal to something more than ¾° and 2° F. for the slate and coal respectively, which balance is, I conclude, due to chemical action, and as I believe kerosene is more diffusive than water, and so would rush these substances with greater rapidity than water would, thus producing more friction, the balance of heat found is, perhaps on this account, again less than the actual amount due to chemical action.

Returning now to the subject I started with, the supposed direct hydration of clay-slate by water, and bringing results just stated to bear upon this question, it certainly appears that this substance evolves heat when mixed with water, which heat is the result of *chemical action*, and the only agency to which I can attribute this chemical action is the hydration of the clay-slate used.

Thus the statement hazarded as to the direct hydration of clay-slate by water receives support upon the ground I have just traversed.

Applying now the facts just elicited in a general manner, it appears—

(1). That in the disintegration of rocks or soils heat is evolved.

(2). That the differences in temperature sometimes observed between contiguous strata may be due, wholly or partly, to this cause.

(3). That our native anhydrous coals hydrate upon their surfaces when exposed to water or aqueous vapour.

(4). That hygroscopic water is chemically-combined water.

(5). That the quantity of water present in certain rocks or minerals may, when known, frequently indicate the highest temperature to which they have been subjected.

(6). That the bulk of vegetable matters (leaves, twigs, &c.) generally develope heat by hydration, also by friction, when the temperature of the air surrounding them is lowered.

In regard to these statements it requires, in the case of (3), gravimetrical experiments to support it, which I shall presently endeavour to obtain, and if they should prove it a correct one, that is, that anhydrous coal can hydrate and to any notable extent, it will certainly appear that these substances have been formed at a somewhat elevated temperature, perhaps approaching to nearly 100° C.

While upon the subject of the formation of coal, I would just like to observe here, that I cannot avoid thinking the effects of pressure in consolidating this, and indeed other minerals, also rocks, has been considered much greater than they really have been or are now, and this because it seems that these subjects will generally, if not always, be charged with water, oil, or gas, and, if this is so, I conceive the consolidating action of pressure would be very greatly mitigated, and would be in some proportion to its actual volumetrical effect upon the liquid receiving it. I cannot see how particles suspended, or thoroughly soaked with a liquid, can be made to approach each other by pressure, except by allowing the liquid to escape, and it does not appear, in the case of rocks, &c., at some depth, that there can be any such way of escape,

at least a sufficiently ready one for the liquids or gases lodged in their pores.

In reference to the statement (4) that the hygroscopic water of substances retaining it is combined water, this appears certain from what has been described, and also from other considerations. Thus, to take an analogous case, the salt chloride of silver forms a definite crystallisable chemical compound with ammonia, but, though acknowledged as such, it can only be preserved in an atmosphere of ammonia, and if this gas is taken away as evolved, the mineral loses the whole of it, even at common temperatures; if this was not obviously a definite mineral we might have extended the meaning of the term hygroscopic, given it a general application, and styled the ammonia thus retained *hygroscopic*. Now I conceive water has relations to the so-termed hygroscopic substances, similar to those ammonia sustains to argentic chloride; it chemically combines with these substances, and the compounds thus formed are not permanent, except at a temperature not higher, and a tension of aqueous vapour not less, than that at which they were produced.

Lastly, as to a production of heat by the chemical combination of water with the substances of plants, a combination brought about by changes in the temperature of the air, or in the tension of its vapour, this is no doubt a very useful provision for preventing sudden atmospheric changes of this nature affecting the vegetable world abruptly.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.
Thursday, December 17th, 1874.

Professor J. H. GLADSTONE, F.R.S., Vice-President, in the Chair.

THE minutes of the preceding meeting having been read and confirmed, Mr. F. B. Benger was formally admitted a Fellow of the Society. The names read for the first time were those of Messrs. R. E. H. Goffin, W. Armstead, M.B., W. McCowan, J. W. Biggart, and D. Johnson. Messrs. Edward Wethered, William Henry Symons, William Wade Hyde, James Alfred Kendall, David Bendix, John McDougall, Henry Penley Harris, and Edward Sonstadt were balloted for and duly elected, after their names had been read for the third time.

The first paper, "*On Groves's Method of Preparing Chlorides,*" by C. SCHORLEMMER, F.R.S., was read by the Secretary. The author finds that, on passing hydrochloric acid into a boiling mixture of heptylic alcohol and zinc chloride, pure heptylic chloride is not produced, but a mixture of heptenes with both the primary and secondary heptylic chlorides. Amylic alcohol treated in a similar way yields the primary and secondary amylic chlorides mixed with some diamyl ether. These results, the author believes, explain the peculiar action of zinc chloride; the alcoholic chlorides being produced by two distinct reactions, one part by the union of the acid with the olefine in the nascent state, and the other by the direct action of the acid on the alcohol.

Mr. C. E. GROVES said it was not difficult to give a hypothetical explanation of the production of the alcoholic chloride, but it must be remembered that the distinctive action of zinc chloride was the *complete* conversion of the alcohol into the corresponding chloride, and the *perfect* absorption of the hydrochloric acid during the reaction. It did not seem to him that Dr. Schorlemmer's hypothesis satisfactorily accounted for this.

Mr. E. NEISON remarked that, if secondary octylic alcohol were heated with zinc chloride, it was almost com-

pletely converted into octylene, and when hydrochloric acid is passed into the pure boiling alcohol very little octylic chloride is produced; the simultaneous action of zinc chloride and hydrochloric acid, however, rapidly converted 70 to 80 per cent of the alcohol into the chloride. In the case of ethylic alcohol, although zinc chloride alone does not reduce it to the olefine, the simultaneous action of hydrochloric acid enabled it to do so, combining with the nascent olefine to form ethyl chloride.

The CHAIRMAN having thanked the author,

A note "*On the Precipitation of Metals by Zinc*," by J. L. DAVIES, was read. The author finds that zinc does not precipitate nickel, cobalt, or iron from acid solutions, but the two first are readily precipitated from ammoniacal solutions, and iron to a considerable extent in solutions containing salts of ammonia.

Mr. W. H. WALENN said that the addition of ammonia enabled zinc to precipitate iron in the metallic state; he had also observed that zinc would precipitate brass from a cyanide solution containing ammonium tartrate.

Dr. GLADSTONE remarked that Dr. Russell had called the attention of the Society to the fact that, in precipitating a solution of copper by zinc, the former metal was found to contain a very large amount of zinc. This was explained by the secondary reaction which takes place, the zinc salt produced being decomposed by the voltaic current formed by the two metals.

Papers entitled "*Researches on the Paraffins existing in Pennsylvanian Petroleum*," by T. M. MORGAN, and "*Some Remarks on the Preceding Paper*," by C. SCHORLEMMER, F.R.S., were then read.

Mr. MORGAN finds that normal hexane boiling at 68° to 70° C., when chlorinated, yields a mixture of mono-chlorides, boiling at 120° to 134° C. Alcoholic potash converts about two-thirds of this into olefines boiling at 68° to 70° C. By treatment of these olefines with hydrochloric acid in the cold, a part was converted into the chloride. Potassium acetate decomposed this, with regeneration of hexene. The alcohol obtained from this, by combining it with hydriodic acid, decomposing the product with lead acetate, and finally treating the hexyl-acetate so obtained with alcoholic potash, boiled at 125° to 129° C., and had the odour of peppermint. The hexene, which was unattacked by hydrochloric acid in the cold, was found to yield an alcohol boiling at 132° to 137° C.; from the products obtained by its oxidation, it appears to be methyl-butyl-carbinol. The normal heptane from the same source, boiling at 96° to 99° C., when chlorinated and submitted to processes resembling those above mentioned, yields two alcohols, boiling at 140° to 141° C., and at 155° to 158° C., respectively. The latter is the methyl-pentyl-carbinol already investigated by Schorlemmer.

Dr. SCHORLEMMER thinks that, from Mr. Morgan's experiments, it is probable that Pennsylvanian petroleum contains, besides the normal heptane and the isomeride boiling at about 90° C., a third isomeric hydrocarbon. It is possible, however, to explain the author's results in another manner. In order to decide the question, it will be necessary to use an absolutely pure paraffin; that which appears to be best adapted for this purpose is the normal hexane from mannite. The author intends to examine this point very carefully, and also to study the derivatives of normal octane prepared from methyl-hexyl-carbinol.

The CHAIRMAN having thanked the authors in the name of the Society,

Mr. D. HOWARD read a note "*On Aricine.*" Hesse, in his paper "On the Cinchona Alkaloids, refers to the very unsatisfactory state of our knowledge of aricine, the very existence of which he is inclined to doubt. The author, however, believes the cause of this is, that barks containing aricine, which were plentiful in commerce at the time when Pelletier and Winkler wrote on the subject, being valueless, have ceased to be imported. A quantity of aricine-yielding bark still existing in the collection of Mr. J. E. Howard was, however, placed at the author's disposal, and he finds, besides kinic acid and quinovine, that it contains a yellow colouring matter, and the alkaloid aricine, whose properties and chemical reactions are quite distinct from quinine, quinidine, cinchonine, cinchonidine, quinamine, quinicine, and cinchonicine. It gives a specific rotary power of 63° to the left for the yellow ray. The quantity of alkaloid was too small to enable the author to determine its composition.

In reply to a question of Dr. GLADSTONE,

Mr. HOWARD said that, besides the well-defined group of alkaloids, quinine, quinidine, quinicine, cinchonine, cinchonidine, and cinchonicine, there were four others occurring in reputed cinchona barks, viz., paytine, paricine, beerberine, and aricine, which appear to form a group apart. It was a point of great interest, both botanically and chemically, to ascertain whether these occurred in any of the true cinchonas. Nothing was at present known on this subject.

The CHAIRMAN, having thanked Mr. Howard, announced that Professor Clerk Maxwell had promised to give a lecture, on the 18th of February next, "On the Dynamical Evidence of the Molecular Constitution of Bodies."

The meeting was then adjourned until Thursday, 17th of January, 1875.

NOTICES OF BOOKS.

Inorganic Chemistry: Theoretical and Practical. First Course. By T. JAMIESON, F.C.S. Aberdeen: Free Press Printing Company.

WERE our higher chemical literature, and especially our original researches, at all proportioned in quantity to the amount of elementary chemical works issued from the British press, our position would be high indeed. The number of manuals, handbooks, epitomes, and lecture notes that have appeared, and are still appearing, is great indeed. None of these productions can be pronounced worthless. As a rule they give a correct account of established facts and of temporarily-established theories. Each of them can scarcely fail to have, in some point or other, the advantage over its rivals. But for all this we are often sorely puzzled to find any valid plea for the existence of the majority. Until some novel leading fact shall be established, or some really valuable generalisation attained, we could wish that the authors of such would works would pause.

The volume before us treats of seven of the non-metallic elements only, whence we must conclude that further parts are in course of preparation. The work may undoubtedly claim the merit of clearness. Marginal notes furnish a running summary of the text, and will greatly assist the student in recapitulating. The experiments to be made, the results observed, and the inferences to be drawn are arranged in parallel columns. The book is also interleaved with blank writing-paper, so that the student may note down anything of importance heard or seen at lectures. In short, whatever can be done by the aid of judicious arrangement, by the use of varied type, by tabular and graphic representation, to give the highest prominence to what is of the greatest importance, and to fix it in the mind of the student, hoping that it may by the principle of association recall the secondary matter, has been done here. This is, we believe, all that the author claims. The work, as he himself tells us, "contains no new fact, and presents no originality, beyond that of expression, arrangement, and illustration." He writes, indeed, for students seeking to "pass" the examinations of the Department of Science and Art, a circumstance which appears to have given a certain bias to his teachings, from which we should be glad to see him freed. As a consequence of that bias he sometimes advances views which are not incapable of being controverted. The present brief notice is not, however, the place for entering upon such a discussion. We will merely say that, whilst

his shortcomings are those of the school he represents, his merits are indisputably his own.

Five Hundred Chemical Experiments for One Shilling. Arranged for Young Beginners in Chemistry. By F. MOUTIER. London: Townson and Mercer.

THE author tells us in his preface that "a want has been felt which the following Five Hundred Chemical Experiments is designed to meet." The nature of the work may be sufficiently understood from the title. We are bound to admit that, generally speaking, correct instructions are given for the performance of the experiments, and the lesson to be learnt from each is made sufficiently clear. In a few cases we should be disposed to say, repeating the well-known advice of Punch to persons about to marry —"Don't." The preparation of iodide of nitrogen is hardly adapted for young beginners. The development of hydrofluoric acid in a leaden tray eight inches square, is likewise quite unfit for any ordinary room. Under a draft-hood, or in the open air, it may be attempted in safety.

We read under experiment 165, that "the foul smells from drains may thus be destroyed: hence chlorine is a disinfecting agent." We submit that to deodorise and to disinfect are by no means convertible terms.

In experiments 358 and 359 we are told that chrome-red is made by adding solution of lead acetate to potassium dichromate, whilst if the neutral chromate is employed, the result is chrome-yellow. This is by no means correct; chrome-yellow is ordinarily made with the dichromate, whilst chrome-red may be obtained by grinding up litharge with a little strong potash lye and then adding, in the cold, one-quarter of its equivalent of dichromate. To the above, and a few other oversights, we would beg to call the attention of the author in case of a second edition.

Taken as a whole, however, the work may be described as by no means ill-calculated to answer its purpose.

Fibrin and White or Colourless Corpuscles: their Nature and Origin in the Animal Organism. By J. GOODMAN, M.D. Edinburgh: J. Lindsay.

THE author describes, in this pamphlet, the production of fibrin from the serum of blood, by the agency of water. Egg albumen, also, if immersed in cold pure water, and exposed for some little time to its influence, loses the characters of albumen, assuming the nature, appearance, and constitution of fibrin. It is necessary for the success of these experiments that the egg albumen should not be old, nor the blood serum long drawn. If these precautions are neglected, or if the water employed be close upon the freezing-point white corpuscles appear, instead of fibrin. The "fibrinised" egg, or artificial fibrin, has been recommended as one of the most easily digestible ailments known. For this purpose an egg is stripped of its shell and plunged in at least a pint of cold water, where it is suffered to remain for at least twelve hours. The water is then raised to a boil.

The Safe Use of Steam; containing Rules for the Guidance of Unprofessional Steam Users. By AN ENGINEER. London: Lockwood and Co.

A MARVEL of practical instruction for the arrangement of steam-boilers. Were the precautions here laid down duly attended to, we should be far less frequently pained by the account of a boiler explosion and its attendant massacre.

Journal of the Society for the Promotion of Scientific Industry. April, 1874. Manchester: Published by the Society.

THIS number contains the opening address of the President, Earl Derby, and a paper by Mr. Lowthian Bell on the economical consumption of fuel.

CORRESPONDENCE.

ASSAY OF LEAD.

To the Editor of the Chemical News.

SIR,—I think the following process for the management of the assay of lead in ores will be found convenient, particularly where, as is often the case, the lead to be estimated is mixed as sulphate with the matrix insoluble in acid.

I dissolve the sulphate or chloride as the case may be in acetate of ammonium, make the solution as neutral as possible, and estimate the lead by a standard solution of bichromate (a half decinormal solution answers well) with a nitrate of silver indicator.

There is nothing very new in any particular point of this method, only I think the volumetric estimation of lead-sulphate dissolved in ammonium acetate by the bichromate has not been yet applied, and, as it shortens labour, enables the insoluble matrix to be weighed direct after drying, and gives accurate results, I think well to mention it.—I am, &c.,

F. MAXWELL LYTE.

6, Cité de Retiro, Faubourg St. Honoré.
Paris, December 16, 1874.

FERROUS SULPHIDE IN CHAR.

To the Editor of the Chemical News.

SIR,—In reply to Mr. Murphy's letter (CHEMICAL NEWS, vol. xxx., p. 282). I have to repeat that in my experience the most reliable results were obtained by oxidising the the sulphur in the char itself. If Mr. Murphy received a sample of ferrous sulphide for analysis (a commercial sample), I presume he would not apply the evolution method for the estimation of sulphur. As applied to char, in my opinion it would be deceptive and misleading. But I will not take up space discussing such a question.

Mr. Murphy fancies that the calcium sulphides must be heated to their melting-points before they would part with their sulphur to iron. Again, I ask Mr. Murphy to try the experiment. He will find a very low red heat quite sufficient to obtain spongy ferrous sulphide from a mixture of calcium sulphides and reduced iron.—I am, &c.,

R. FRAZER SMITH.

ESTIMATION OF FIXED OIL IN ADULTERATED CITRONELLE.

To the Editor of the Chemical News.

SIR,—The following are the details of a process for estimating the amount of "fixed oil" in adulterated citronelle, which in the absence of information in available books, I was obliged to devise recently. This method yields constant results when managed with care, and when taken in conjunction with the specific gravity of the sample may give a good approximation as to the quantity and the class of the adulterating oil. I should be very glad to be instructed by having possible errors in the process pointed out, or to be put in the way of finding a better one.

A. Dissolve about one ounce of caustic potash in five ounces of alcohol in a flask; put on a sand-bath, and leave to boil.

B. Tare an 8-oz. beaker and weigh into it 400 to 500 grains of the citronelle; add two volumes of alcohol; boil on a sand-bath.

C. When A and B are both boiling, add one volume of the alcoholic solution of potash to the three volumes of alcohol and citronelle. Boil for a minute or so and then fill to within an inch of the top with distilled water. Stir gently, and let boil for about half an hour or until the

upper layer is perfectly clear, and the under-fluid semi-transparent. Then allow to cool.

D. When quite cold, syphon off the under-fluid (containing water, alcohol, and potash, and *soap* if any fixed oil was in the sample) very carefully into another beaker and boil gently. Acidify with dilute H_2SO_4. Add 50 or 100 grains of wax, continue gently boiling till the oily layer is perfectly clear, and then allow to cool gradually.

E. When cold remove the cake of fat, dry, and weigh. The weight, less 50 or 100 grains of wax, is the amount of fatty acid contained in the fixed oil. A simple calculation will show the amount per cent of the adulterant in the citronelle.—I am, &c.,

<div align="right">T. A.</div>

COMMERCIAL ANALYSES.

To the Editor of the Chemical News.

SIR,—Having recently had occasion to doubt the accuracy of a rather unknown (in the commercial world) analyst, we submitted a portion of the original sample to a third chemist; results enclosed. A. and B. are the original tests; C., result of B.'s duplicate, showing a difference of nearly 4 per cent—in other words, a loss of £100 on the cargo. It is, indeed, high time some steps were taken to prevent these frightful discrepancies.—We are, &c.,

<div align="right">PICKFORD & WINKFIELD.</div>

148½, Fenchurch Street, London, E.C.,
December 9, 1874.

A.		B.	
Moisture	2·96	.. ..	5·63
Undetermined	2·32	Water of hydration ..	7·19
*Phosphoric acid	32·16	.. ..	30·86
Lime	49·61	.. ..	40·58
Oxide of iron .. .. .. } Alumina, magnesia, &c., } not determined	2·95	Oxides of iron and alu- } mina .. .. }	5·32
†Carbonic acid	7·25	.. ..	3·28
Insoluble matter	2·75	.. ..	2·66
		Sulphate, fluoride of } lime, magnesia .. .. }	4·48
	100·00		100·00
*Equal to tribasic phos- } phate of lime .. .. }	70·22	.. ..	67·27
†Equal to carbonate of } lime .. .. }	16·47	.. ..	7·45

C.	
Moisture	3·40
Water of combination	4·65
*Phosphoric acid	32·59
Lime	45·75
Oxide of iron .. .. } Alumina, magnesia, &c., not determined }	4·03
+Carbonic acid	6·63
Insoluble matter	2·90
Undetermined	0·05
	100·00
*Equal to tribasic phosphate of lime..	71·15
†Equal to carbonate of lime	15·06

DEODORISING OILS.

To the Editor of the Chemical News.

SIR,—Some little time ago I addressed a query to you asking whether any of your subscribers could give me information of how to efface or drown the smell of petroleum or paraffin oil.

These oils would be of great use to the medical profession for outward applications if the disagreeable odour could be got rid of.—I am, &c.,

<div align="right">W. HUGHES.</div>

2, Abingdon Road, Kensington.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences, No. 21, November 23, 1874.

Recent Improvements in Electro - Magnetic Machines.—M. Z. T. Gramme.—The author announces that he has constructed one machine for the electric light, two for galvano-plastic, and some small machines for scientific demonstration. The machines for demonstration can heat to redness 0·10 metre of platinum wire of 3-10th millimetre in diameter. Those at present made in the workshops of M. Breguet, and in the author's own, redden 0·40 metre of the same wire (*i.e.*, four times more than the former) without any variation, either in the weight of material or in labour. This increase in the intensity of the current is mainly due to the new foliated magnets of M. Jamin. One of the galvano-plastic machines has been working for two years, to the entire satisfaction of the purchasers. It has required no repairs, and no outlay beyond greasing the axle. Some of the author's machines deposit 0·6 kilo. of silver hourly. The new galvano-plastic machines have only one central ring in place of two bars of electro-magnets in place of four. Like its predecessors it deposits 0·6 kilo. of silver hourly, but the force required for its motion is only 50 in place of 75 kilogrammetres. It requires less space by one-half; its gross weight is reduced three-fourths; the copper required in its construction is also reduced three-fourths, and it economises 30 per cent of motive power.

Saccharine Matter Contained in Mushrooms.—M. A. Muntz.—In former researches (*Comptes Rendus*, lxxvi., p. 649) the author has shown that mushrooms contain saccharine matter in the form of mannite, of trehalose, or a glucose of a species not determined. The part played by this sugar in the life of the plant is very important. It is the form through which the carbon commonly passes both in approaching and in departing from the maximum of oxidation. This circumstance has led the author to examine the lower fungi which play the part of ferments and moulds. In the true ferments, such as beer-yeast, he has not been able to prove the presence of mannite and trehalose. The moulds, on the other hand, have yielded the bodies in question very distinctly. *Penicillium glaucum*, cultivated in solutions of starch, inverted sugar, tartaric acid, and gelatin, to which the needful mineral elements were added, contained constantly in its tissues a very appreciable quantity of mannite. The production of mannite at the expense of the elements of tartaric acid deserves attention. The constitution of these two bodies differs widely. The molecule of tartaric acid is more simple, and contains a less quantity of equivalents of carbon. The *Penicillium*, therefore, effects a true synthesis, in a manner accessory to its principal function, which is a complete combustion, the reverse of the synthetic function, which is more characteristic of the plants containing chlorophyll. *Mucor mucedo*, cultivated on horse-dung, putrescent kidney-beans, &c., yielded trehalose, but no mannite. In this respect, the moulds rank with the higher fungi. The myxomycetes are placed by some authorities between animals and plants, and by others among the fungi. It was, therefore, interesting to examine what sugar they contain. *Ethalium septicum* yielded abundance of trehalose—a fact which tends to connect these plants with the fungi.

Effects of Sulpho-Carbonate of Potassium upon the Phylloxera.—M. Mouillefert.—The experiments appear to have been successful where the quantity of water was sufficient to carry the sulpho-carbonate thoroughly into the soil.

Means Followed to Discover the Substance Most Effectual for the Destruction of the Phylloxera.—M. Max Cornu.

Experiments made on the Shoots of the Vine Plunged into Water Holding Various Substances in Solution.—M. A. Baudrimont.

Certain Facts Relating to the Phylloxera, to the Submersion of Vines and Corn; Application of Naudin's Process to Vines which cannot be Submerged.—G. Grimaud.

Influence of Temperature on the Coefficient of the Capillary Flow of Liquids.—M. A. Guerout.—The author shows that the coefficient of the flow of a liquid increases or decreases very rapidly, in consequence of a rise or fall of temperature. For a rise of 10° C., the coefficient of flow—in other words, the mobility of the liquid—is increased by one-third. This increase of mobility corresponds to a decrease of cohesion between the molecules of liquids, showing that when a liquid, on being heated to a sufficient temperature, is resolved into vapour, it is in consequence of the progressive weakening of the cohesion which binds its molecules together that this force is destroyed so as to permit vaporisation. This influence of temperature upon the mobility of liquid molecules is possibly felt in the flow of liquids through the capillary vessels of the organism. The action of cold, which is known to arrest circulation in the tissues, may be due, not to congelation, but to the partial destruction of the mobility of organic liquids.

Product of the Addition of Propylen to Hypochlorous Acid.—M. L. Henry.—Not adapted for abstraction.

Bulletin de la Societe Chimique de Paris,
Nos. 6 and 7, October, 5, 1874.

Determination of Tannin.—MM. Muntz and Ramspacher.—The principle of the method is as follows:—A solution of tannin, filtered by pression or aspiration through a piece of hide, gives up to it all its tannin, whilst the rest of the dissolved matters pass through the animal tissue. The authors have satisfied themselves by direct experiment that the matters which may accompany the tannin, such as saccharine and gummy substances, organic salts of potash, lime, magnesia, &c., are not retained by the hide. On evaporating to dryness equal quantities of the solution, filtered and unfiltered, and deducting the weight of the former residue from that of the latter, we find the exact weight of the tannin absorbed by the hide. As an example: 50 grms. of oak-bark, ground in a coffee mill, are exhausted with boiling water, so as to make up 250 c.c. of liquid. A piece of hide, free from hair, and previously softened in water, is stretched over a small zinc drum of about 0·06 metre in diameter, and secured in its place with a copper wire. The opposite end of the drum forms a tube, to which is attached a tube of caoutchouc from 1·5 to 2 m. in length, and terminating above in a funnel. Into this is poured the solution of the sample. The first 4 or 5 c.c. of the filtrate are rejected because they contain certain albumenoid matters expelled from the hide by displacement. After having thus collected by filtration a certain quantity of the liquid, 25 c.c. of the filtrate are evaporated to dryness at 100°, and also 25 c.c. of the unfiltered solution; we have then—

Weight of tannin and foreign matter .. 0·465 grm.
Weight of foreign matter alone .. .. 0·175 ,,
                                        ————
                                        0·290 ,,

being the weight of tannin present in 25 c.c. of liquor. The total volume of this liquor being known, and the amount of bark from which it is obtained, the percentage of tannin in the latter is found by a very simple calculation.

Phosphates of Sesquioxide of Iron and of Alumina.—M. Millot.—The author has obtained phosphates of sesquioxides of the following formulæ :—

$$PO_5, M_2O_3 nHO, -3PO_5, 2M_2O_3 nHO 2PO_5 Mn_2O_3, nHO.$$

Phosphate of sesquioxide of iron, $PO_5, Fe_2O_3, 5HO$, is formed by pouring an excess of phosphate of soda into a salt of sesquioxide of iron, or by precipitating a solution of one of the following phosphates by an excess of acetate of soda. It is a white gelatinous precipitate, which, if dried at 100°, answers exactly to the above formula. If ignited it gives the anhydrous salt, $PO_5 Fe_2O_3$, insoluble in acids, but attacked by alkalies. $3PO_5, 2Fe_2O_3, 10HO$.—Rammelsberg finds this phosphate to form cubic crystals, and has obtained it by setting aside for a year a saturated solution of the former salt. Large quantities of this salt may be obtained by treating oxide of iron with an excess of phosphoric acid, either in the cold or at a temperature of 100°. A little water is added, and the solution is filtered. A clear liquid is thus obtained, which, when mixed with water, deposits a little phosphate. The precipitation is much more complete on the application of heat. If the quantity of water is sufficient we obtain an abundant deposit, which towards 100° occasions violent projections. It is filtered whilst still boiling, and yields, after washing, the above compound. If the liquor is left to itself in the cold the precipitate re-dissolves in the course of a few days, but may be thrown down again by boiling. The same compound may be obtained by mixing 3 equivs. of acid phosphate of ammonia and 2 equivs. of sulphate of sesquioxide of iron, and heating the liquor to ebullition. On ignition it yields $3PO_5, 2Fe_2O_3$, insoluble in acids, but attacked by alkalies. $2PO_5, Fe_2O_3, 8HO$ is obtained by treating the foregoing with 2 equivs. of phosphoric acid, or by attacking oxide of iron, hydrated or anhydrous, with excess of phosphoric acid, treating with water to remove the dissolved substance, and repeating this procedure several times. The compound is obtained as residue. The oxide of iron, insoluble in concentrated acids and in aqua regia, is attacked by phosphoric acid in the cold, or at 100°. The salt, ignited, yields the anhydrous phosphate, $2PO_5, Fe_2O_3$, insoluble in acids, and attacked by alkalies. These three hydrated phosphates have properties very much alike. They lose their last equivalent of water between 170° and 180°, and become insoluble in acids. When hydrated they are very readily decomposed by salts. Oxalate of ammonia at the boiling-point, and the alkaline salts, and citrate of ammonia in the cold, dissolve them completely. They are insoluble in water and acetic acid, but become slightly soluble in the latter if mixed with salts of lime. (2) *Phosphates of Alumina,* $PO_5, Al_2O_3, 5HO$.—This salt is prepared by precipitating sulphate of alumina with phosphate of soda, leaving the liquor decidedly acid, filtering, and drying at 100°. When ignited it yields PO_5, Al_2O_3, insoluble in acids, soluble in alkalies. $3PO_5, 2Al_2O_3, 20HO$.—This salt can only be obtained by dissolving alumina in phosphoric acid, and boiling the solution, when the phosphate is precipitated, carrying down with it a variable excess of alumina. The author has likewise obtained it by boiling 3 equivs. of acid phosphate of ammonia and 2 equivs. of sulphate of alumina in presence of a certain quantity of free sulphuric acid, which dissolves the excess of alumina. On ignition this salt yields $3PO_5, 2Al_2O_3$, anhydrous, and insoluble in acids. $2PO_5, Al_2O_3, 8HO$ is obtained by treating 1 equiv. of the former salt in the cold or at 100° with 2 equivs. of phosphoric acid. The insoluble residue is washed and dried at 100°. On ignition this salt yields $2PO_5, Al_2O_3$, insoluble in acids, but attacked by alkalies. This anhydrous compound is also formed by igniting a salt of alumina with excess of phosphoric acid, like the corresponding salt of iron. These phosphates have the same properties as the corresponding salts of iron, but their solubility in saline solutions is much greater. The phosphates of sesquioxides have the curious property of not dissolving immediately in concentrated acids, whilst they dissolve readily in the same acids on dilution if the time of action is prolonged.

On Isoterebenthen.—J. Ribau.—A description of this body, of its mono- and bi-hydrochlorate, and of its conversion into cymen. It appears to furnish the same cymen as terebenthen and tereben.

Isoterebenthen from a Physical Point of View.—J. Ribau.—The point of ebullition is 175°, or 20 below that of its isomers. Its rotatory power is, at 23° C.,—

$$\begin{array}{cc} \text{I.} & \text{II.} \\ (a)\ j: -9°,\ 17. & -9°,\ 72. \end{array}$$

Its specific gravity ranges from 0·8586 at 0° C. to 0·7793 at 100°. Its index of refraction, at 25° C.,—

Ray.	Length of Wave.	Indices.
Red	0·00065618	1·4677
Yellow	0·00058920	1·4709
Green	0·00051739	1·4760
Blue	0·00044810	1·4839

Solid Polymer of Oil of Turpentine, Tetraterebenthen.—J. Ribau.—This isomer is solid, amorphous, brittle, of a pale yellow, quite transparent, of conchoidal fracture, and easily pulverised. It is easily rendered electric by friction. It is almost insoluble in alcohol, but soluble in ether, sulphide of carbon, benzol, petroleum, and oil of turpentine, from which it is deposited on evaporation as a colourless varnish. It turns the plane of polarisation to the right, $[a]j = +20°$. Its specific gravity at 0° = 0·977. It melts below 100°, and does not distil at 350°. Oil of turpentine yields with protochloride of antimony a characteristic red colouration.

Correspondence from St. Petersburg.—This consists of a brief notice of trimethylacetic acid and pivalic acid, by M. Boutlerow; of iodide of ethyliden, by M. Gustavson; and of the synthesis of dimethyl-isobutyl-carbinol, by M. Parlof.

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Reimann's Farber Zeitung, No. 40, 1874.

Aniline Blacks.—The following mixture is given for cylinder printing:—1 k. 590 grms. chlorate of potassa; 1 k. 590 grms. sal-ammoniac; 1 k. 500 grms. moist sulphide of copper; 3 k. 600 grms. white starch; 23 litres of water. This is boiled, stirred until cold, and mixed with 3 k. 170 grms. "sublimed aniline salt," previously dissolved in 9 litres of cold water. It is then ready for use. The deficient intensity of aniline blacks generally arises from the circumstance that the colours are prepared with so-called "red oil," a residue of the manufacture of magenta, which contains various impurities.

The editor gives receipts for dyeing a black on half-woollen goods (cotton warps); a steam cochineal-red for cotton yarn and cloth; a fast methyl green upon woollen yarns, grounded with Nicholson blue; a silver grey, a ponceau and a brown on woollen cloth; a black for printing woollen yarns; an aniline blue for silk dyeing; a dressing for blue printed goods and muslins; a vat-blue on cotton, with a catechu grornd; a blue-black on cotton velvet; and directions for printing red, white, and black on calico and muslin.

M. Gros-Renaud gives the following instructions for a fast puce with alizarin:—The mordant is an aceto-nitrate of sesquioxide of chrome, and may be used also along with logwood liquor for steam-blacks. It is prepared by placing a stoneware pan, of the capacity of 30 litres, either in the open air or in a roomy place. It is warmed, and 3 kilos. of coarsely pulverised chromate of potash are put into it, along with 4 litres 400 c.c. of boiling water, 2 lit. 600 c.c. of white glycerine at 28° B., and 4 lit. 280 c.c. of acetic acid at 7° B. When the chromate is dissolved, the liquid is poured into a copper pan fitted with a steam-jacket, heated to boiling and kept at that temperature, until it appears of a fine green if seen in a thin stratum. It is then poured into a stoneware vessel to cool, the liquid is then decanted off, and the deposit of nitrate of potash is washed with 800 c.c. of

cold water, and the washings are added to the liquid. The mordant thus prepared is not sticky, and does not become turbid on mixing with water. When thickened it neither decomposes starch-paste, nor coagulates gum-water. One gramme of pure dry alizarin, natural or artificial, requires 5 c.c. of this chrome mordant at 30° B. For use, 1 litre of this mordant at 3° B. is thickened with 300 grms. of dark calcined starch. The pieces, after printing, are passed for one to two minutes through water containing 10 per cent. of ammonia, and dyed in the ordinary manner with dyewoods, extracts, or alizarin. For dyeing self-colours the pieces are padded in the mordant, dried, passed through ammonia water, washed and dyed.

The total monthly production of artificial alizarin in Germany amounts to 200,000 kilos., replacing one-third of the madder formerly consumed.

No. 41.

Dr. Freise announces that the manufacture of "patent colours" in Göttingen will shortly resume operations.

Freeing Wool from Burls by Chemical Means.—The substance of the process here described has already appeared in the CHEMICAL NEWS.

There are receipts for dyeing a Bismarck brown, a fast cherry-brown, and a maroon, on woollen yarn; for bleaching linen; for printing red and brown madder work on calico, and for dyeing "beider wend."

No. 42.

This number contains receipts for dying an olive on wool, a saffranin rose on cotton yarn and pieces; a chamois on garments (half wool), and a green printing colour for muslins. To detect cotton in linen tissues, Böttger, in *Dingler's Polytech. Journ.*, recommends a process founded on the fact that linen fibre, when steeped in an alcoholic solution of corallin, then dipped in a concentrated aqueous solution of carbonate of soda, and finally washed repeatedly with the soda solution, takes a fine rose colour, whilst cotton remains colourless. The sample of cloth must previously be freed from dressing.

NOTES AND QUERIES.

Metallurgical Query.—I have occasion to make bell-metal (alloy of copper and tin) red-hot, and in so doing would wish to infuse into it, by the vapour of the fuel used, bisulphide of carbon, to the exclusion of oxygen and hydrogen. Would any of your correspondents kindly inform me, as I know nothing whatever of chemistry, in what order the use of the following fuels would be likely to further my object? I should be satisfied if I could learn which one would be most likely; wood, charcoal, coke, and coal.—G. POTTER.

MEETINGS FOR THE WEEK.

TUESDAY, 29th.—Royal Institution, 3. "On the Voltaic Battery: the Cell and its Effects" (Juvenile lecture), by Professor Gladstone.

THURSDAY, 31st.—Royal Institution, 3. "On the Voltaic Battery: the Replacement of Metals" (Juvenile lecture), by Professor Gladstone.

SATURDAY, Jan. 2nd.—Royal Institution, 3. "On the Voltaic Battery: Electrical Decomposition" (Juvenile lecture), by Professor Gladstone.

TO CORRESPONDENTS.

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